# AMERICAN MACHINIST

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## The Kingsley Boiler.

The accompanying illustrations, pages 1 and 2, represent an outside view, and a longitudinal section of the Kingsley boiler. The construction of this boiler is very simple, as will be seen by referring to the sectional view. It is composed of two shells; the crown sheet is the top of the inner shell; the remaining part of this shell is placed at equal distances from the outer shell, leaving a water space between the two. The tubes are screwed into the crown sheet and project downwards into the inner shell; the lower ends of the tubes are closed. Above the grate the flues are shorter than in the remaining part of the boiler, so as to leave room for firing. The two shells are stay-bolted, the construction of the boiler giving an excellent opportunity to do so effectively; the braces from the crown sheet to the outside shell are shown in the sectional view.

The heat from the fire at *A* passes backward among the tubes, and when it reaches the rear of the boiler it returns between the outer shell and brickwork or casing, to the smoke-stack. It will thus be seen that the water in the space between the shells is heated on both sides.

The feed water, before it enters into the boiler, is heated by passing through the coil *G*, placed directly under the boiler.

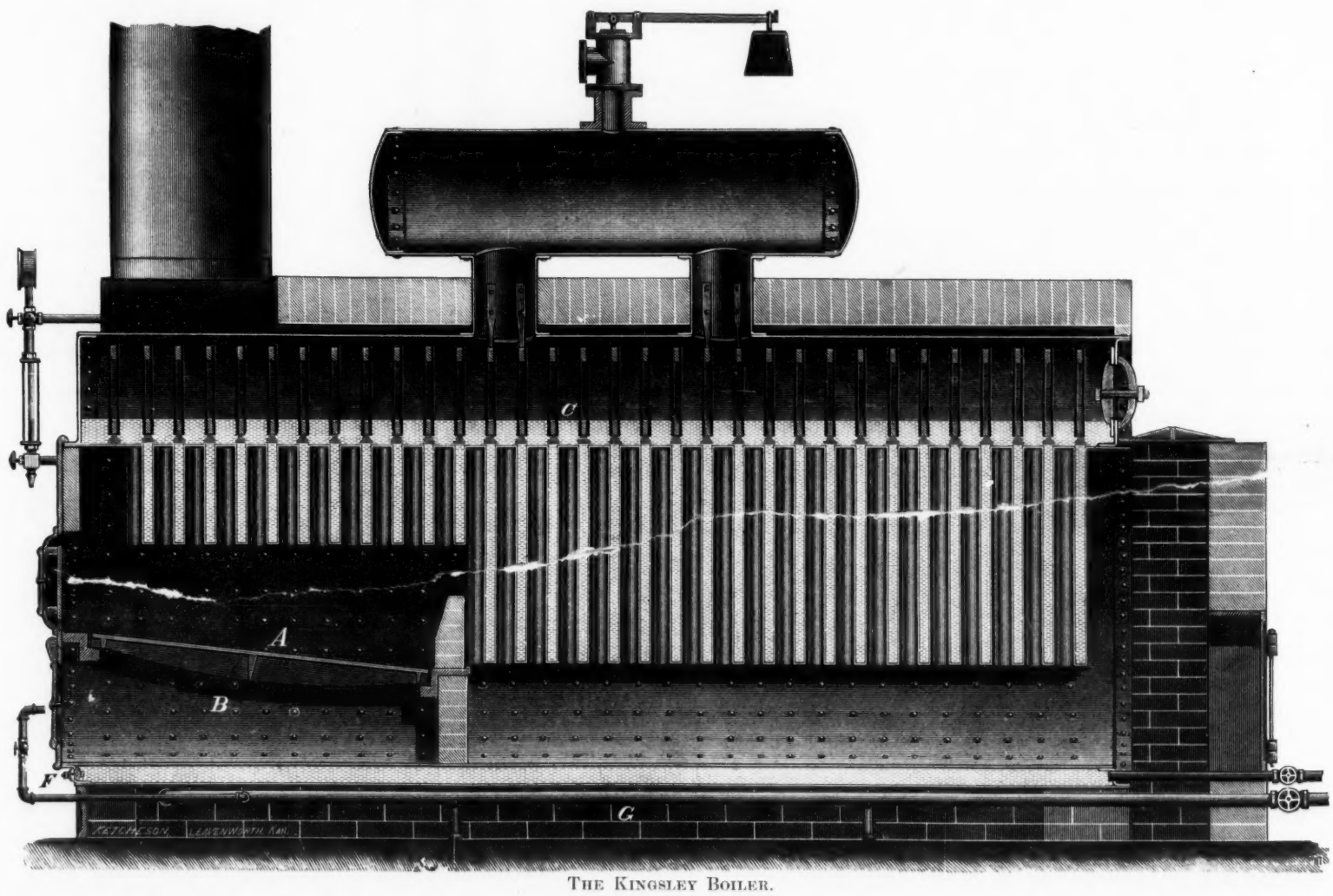
A boiler of this kind is in use in Mr. R. Gair's factory of paper goods in Brooklyn, N. Y. It supplies steam to an engine developing 100 horse-power; besides this, steam is taken from the same boiler to heat 150 glue pots, and also to heat the building, and we are informed that the fuel necessary for these purposes is one chaldron of coke per day.

The dimensions of this boiler are:

| | |
|---|---|
| Length, outside | 14 feet. |
| Width | 38 inches. |
| Height | 72 " |
| Grate surface | 12 square feet. |
| Heating surface | 655 " " |
| Chimney diameter | 24 inches. |
| Height from grate | 47 feet. |

It is claimed that the scientific tests made with this boiler showed an evaporation of 9.971 pounds of water from and at 212°, per pound of coal.

These boilers are furnished by the Kingsley Steam Boiler Manufacturing Company, Washington & Water sts., Brooklyn, N. Y.




THE KINGSLEY BOILER.

## Topical Questions at The Mechanical Engineers' Meeting.

In answer to the topical query, No. 66, "What experiences and phenomena can you describe as to the conduct of steels under the conditions in which you were using them?"—the following letters were read:

In accordance with the request that articles should be contributed to the discussion of the phenomena of steel, I submit the following:

In the discussion at the Nashville Meeting, as to the significance of the peculiar curved lines which appear in the disturbance of the surface scale of steel boiler plates, caused by the strains of shearing, some of the members claimed that it was only a scale disturbance, and did not indicate any injury to the metal.

I have reason to believe, however, that it is an indication of injury to the body of the metal, and send herewith a piece of plate which has been so affected, and afterwards was stretched and broken in a testing machine; the lines show very plainly that the metal had been strained beyond its elastic limit, not only upon the surface, but to some depth (as shown on the edges of the test piece), so that when afterwards it was stretched, it did not so readily yield at these points, leaving elevations of slight extent upon the surface.

The lines on this sample are not so much the peculiar curved ones, the result of shearing, as they are those resulting from the curling of the narrow scrap at the shears, and the subsequent straightening to prepare for testing.

I have observed, as also have many other workers of steel, that metal of some degree of ductility, when subjected to strains, will sometimes crack like glass, showing no evidence of ductility at the point of fracture. I noticed some five years ago one striking case of a ⅝ plate of American-made Basic steel, which was sent to a locomotive works to try, its flanging qualities. It was flanged into a locomotive throat sheet, the edges being first turned down and then the concave end worked out.

The next morning a crack appeared at the opposite end *A* (page 2), which had not been heated at all, and had had the roughness of shearing removed by planing. This crack continued to extend for a week or ten days, until it reached the whole way across to the part that had been heated.

This, of course, was due to the contracting strain at the flanged end, and the sides of the crack showed little or no evidence of having reduced or stretched at the fracture.

I had a test piece taken from the side of the crack (as at *B*), and prepared so that, when pulled, it had the crystalline face of the crack for one edge of the test piece.

The test taken nearly across the grain of rolling showed a tensile strength of 68,580 pounds per square inch, and a reduction of area of 42 per cent., with a fibrous fracture. I send one end of this piece, which, however, is almost too old and rusty to show its character.

I also send some numbers of the "Journal of the Franklin Institute," showing the results of some curious tests made by my father.

One series, 1878, shows that steel and iron, both, when raised to about 600° heat Fahrenheit, lose in ductility and gain in tensile strength; this is also corroborated by bending, and tensile tests made in Europe, and translated for the "Journal of the Franklin Institute," in 1885.

Another set of my father's tests shows the effect of straining iron up to nearly its elastic limit, and continuing the strain for twenty-four hours or more, the result being in some cases, raising the elastic limit almost to the ultimate strength of the material.

I should be glad to be present at the various discussions upon this subject, as they

would no doubt be deeply interesting, but I cannot make it convenient to do so.

Chas. L. Huston.

Lukens Rolling Mills, Coatsville, Pa.

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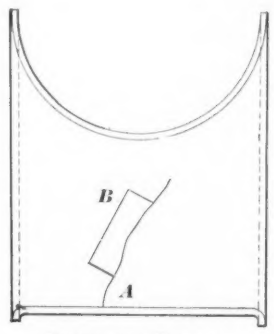
In discussing topic No. 66, I would like to




Damaged Sheet.

call attention of the members to the importance of giving, as far as possible, the history of the steel under consideration.

To those not engaged in its manufacture, steel is steel, but not necessarily so to those engaged in the business. Unless the history of its manufacture is known, much of the other information about it is useless.

Even with the chemical analysis known, which is essential, the great variations in physical properties due to different methods of manufacture and subsequent treatment may account for any anomalies, and unless these are known, the mysterious element of the symposium will not be kept at a minimum.

As no two plates are alike, no two methods alike, and no two men alike, the most complete description of the steel would include the name of the firm and man who made the steel. Then would follow the subsequent manipulation to put the steel in shape for use. Even then the mishaps it has met with from bad workmanship will never be known.

Linden Steel Co. H. D. Hibbard.

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In answer to query 66: During the year of 1883, when re-arranging the driving system at Lawrence Pacific Mills, it was thought that steel shafts for head lengths would be stronger and more desirable than iron. Accordingly, quite a large number of these, of four and five inches diameter, were put in. The calculated sizes were amply sufficient to carry their respective loads, and the shafts were all supported by hangers near the pulleys, and were firmly held.

In less than a year two five-inch shafts had broken in one place, and one in another place, and four four-inch shafts had broken. These were replaced with forged iron shafts which were subjected to the same conditions of load, speed, etc., the bearings remaining the same as before.

The five-inch shafts are still running under the same conditions. The four-inch are still running, although the conditions have more recently been changed. The other steel head lengths, which did not break, were all changed for iron with one exception, which still remains as it was. Chas. T. Main.

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In 1885, I had occasion to make a series of dies and punches for the Estey Organ Company, to be used in punching sheet brass for reeds, both block and tongue, for use in their organs.

The steel was No. 4, Sanderson Brothers Steel Company, Syracuse, N. Y. The bar was cut into various sizes in a planer, heated * * * * in a charcoal fire, and annealed in wood ashes. They were then planed to various sizes and thickness, ranging from $1\frac{1}{16} \times \frac{1}{2} \times 3$ to $\frac{1}{2} \times 3 \times 3$. These were heated to a bright red, in accordance with the instructions printed upon the label on the bar of steel, and hardened in water and ground without the temper being drawn in the least. They were then subjected to grinding in an emery grinder to the proper sizes; they were ground on a frame, but not confined, remaining loose so as to allow the steel to move, if there were any tendency in that direction. As the skin was removed upon one side, the surface was slightly concaved, and they had to be turned over and ground upon opposite sides five times before they ceased changing their form.

The various blocks were planed .010 thicker than the finished size, to allow for grinding. They were ground .001 of an inch alternately on each side, receiving a total of five grindings upon each side, reducing the total thickness .010 of an inch, as above stated.

After they had been ground a few hours, they began to crack, and nearly every one was ruined by reason of this tendency. In some cases they would break into a dozen pieces. I had communication with Sanderson Brothers Steel Company, and they attributed the fact to overheating, but the description, "a bright red," had been strictly followed, and had been none too high for similar steel for a like use.

Samples of this were sent to Sanderson Brothers and tempered by them, and the temper slightly drawn, but it was not sufficiently hard to do the work. We then resorted to steel No. 5, same make, which had precisely the same treatment as first described, and which has resulted in no case in break age.

The work performed by the sample returned to us by the Sandersons was the punching of five thousand reeds without regrinding, while the No. 5 will punch twenty thousand, and with some thicknesses even more.

The dies were perfectly square, and were set with a piece of tissue paper .0005 in thickness between them, cutting a perfectly smooth edge. Levi K. Fuller.

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Having taken part in the discussion on steel at the Nashville meeting, and learned through the authority of a member that electro-plating tempered steel is another illustration "of the unexpected which sometimes happens," and having constant reminders in the same line, I should be interested and instructed by the continuance of the discussion of this topic.

I forward to you the drill spoken of at Nashville. The singular regularity of the fracture is peculiar. The break was not at a shoulder, but about an inch therefrom. As I stated at the meeting, this piece of steel broke during the night, after having been in the hands of a workman for several hours. This shank was forged from larger stock and cooled by dipping in water. There was heat enough to harden it somewhat, as shown in the groove. The cooling no doubt caused the fracture, but why it should have taken several hours before the break occurred, I do not understand. The steel stood rough handling, but broke during the night while lying on a machine—the part shown being found on the floor. I think it is not good practice to hurry the cooling of steel in this way, although the water annealing of steel is usually satisfactory if carefully done. This breaking after hardening is not unusual, sometimes not developing for several days.

One of the members spoke of such an incident happening after months. There may be foundation for the belief that clock and watch springs break during a thunder shower more frequently than at other times, and that a razor is improved in cutting qualities after lying unused for some time.

I forward part of a large tap broken in hardening; the imperfection of the steel is apparent. Such a fracture is common with large tools; whether large tools that do not break have this imperfection or not, it is impossible to know. The majority of sizes 4" and above, that do break, show irregularity in grain somewhat like the sample.

The question naturally arises, "Why should so slight a cause produce this result?" The most common breakage of taps in hardening is at about one diameter from the entering end of the tap. I think by screwing an iron washer over the end of the tool, to keep the water from it, this breakage could be lessened. This could be done by tapping out the center for a small machine screw and holding the washer against the tool by this screw.

I forward some samples of drills cracked in hardening. Much the larger loss from breakage in drills larger than ½ inch, show this peculiar fracture. It is not confined to any part of the twist, though the samples are towards the shank or solid part of the drill. You will notice a peculiar uniformity in the fracture. In all the hundreds I have noticed the fracture never is reversed, or pointing towards the shank. I am convinced that this break is from solid stock, not being caused by an imperfection in the steel.

Geo. R. Stetson.

New Bedford, Mass.

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In answer to the question—How much allowance is wise in shrinkage fits with steel? the following answer was read:

One part in one thousand; that is, $\frac{1}{1000}$th of an inch for every inch in diameter. Reason—Machine steel may be strained to 30,000 pounds per square inch without giving an appreciable permanent set, or exceeding its elastic limit. The modulus of elasticity of steel being about 30,000,000 pounds, a strain of 30,000 pounds causes an elastic stretch of $\frac{1}{1000}$th part of its length. The American Master Mechanics' Association prescribe the following shrinkage of tires:

| | | | | |
|---|---|---|---|---|
| 38" | diam. | .040 | allowance | for shrinkage. |
| 44" | " | .047 | " | " |
| 50" | " | .053 | " | " |
| 56" | " | .060 | " | " |
| 62" | " | .066 | " | " |
| 66" | " | .070 | " | " |

This is about one part in 950.

Wm. Kent.

The following remarks on the shrinkage of steel were made by W. E. Crane, of Waterbury, Conn.:

The peculiarity of steel shrinking when hardened is valuable in many industries, such as dies for drawing tubes, rivets, etc. When a die becomes worn it is a simple matter to take it to the blacksmith and have it re-hardened and shrunk. If steel would do this indefinitely these dies could all be worn out on one size, but there is a limit to the number of times that the same piece of steel will shrink; this number being some five to seven, after which it does not shrink. It is possible that steel might be re-heated and cooled seven or eight times, if it would not be injured, and then the tool ground to size and hardened, and retain its size.

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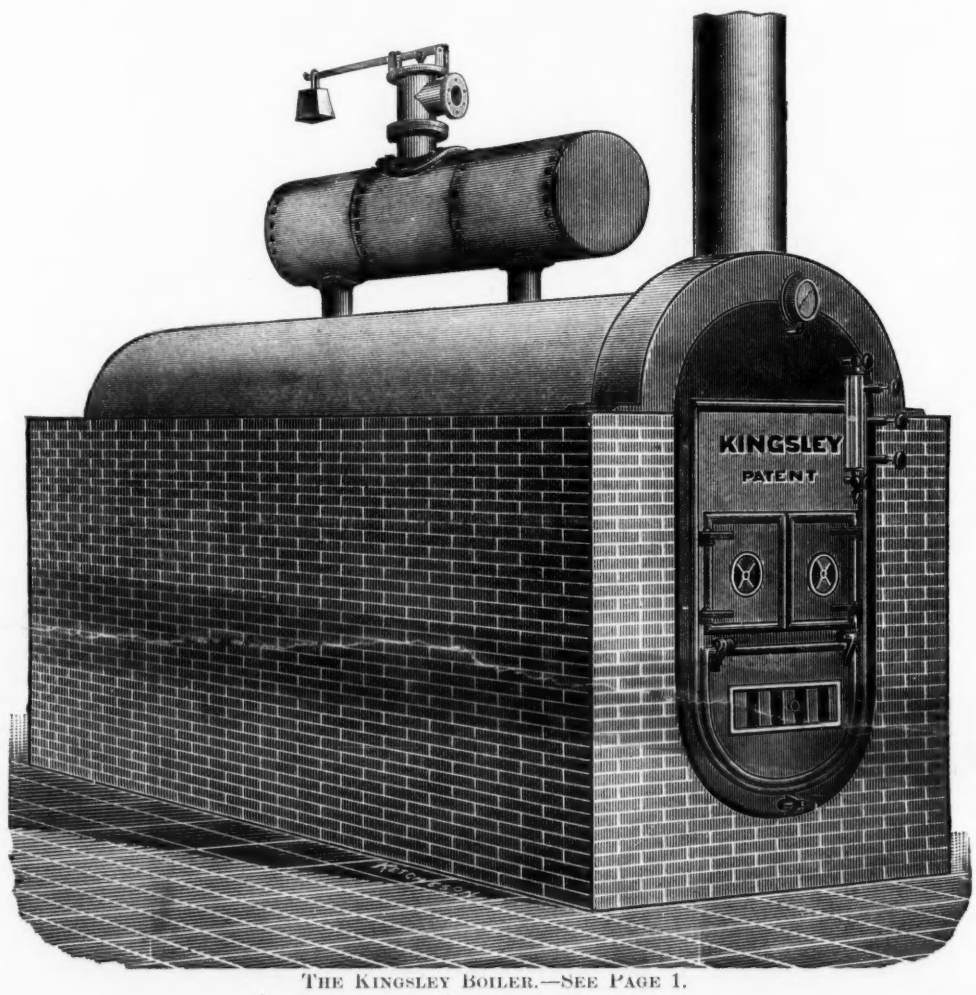


The Kingsley Boiler.—See Page 1.

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Salt was manufactured in Cheshire for many centuries before the salt beds were found. Indeed, it was not till 1670, during some boring operations in search for coal at Marbury, near Northwich, that the top bed was discovered. Mines were worked in it shortly afterwards, but not extensively, there being no means of transporting the output. Fifty years later—1721—the river Weaver, which flows through the heart of the salt district, was made navigable. Communication with the rapidly-developing port of Liverpool being thus established, a great stimulus was given to salt-mining; and in 1732 nearly 10,000 tons of rock salt were sent down the Weaver. In 1781 the bottom bed was discovered, and the quality of it being superior, all new mines were sunk to it, and most of the top mines were abandoned. One after another the top mines collapsed, leaving large funnel-shaped pits to mark their position. In mining the lower stratum, it is the practice to excavate only the lower—and purer—portion of the bed, and to leave very large pillars to support the roof. When the boundary of the owner is reached, water is admitted; and after it has become saturated, it is pumped up as brine, for the manufacture of white salt and of alkali by the ammonia-soda process —*The Engineer* (London).

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A local correspondent of an Ohio weekly paper recently undertook to describe a large manufactory, and, after giving the sizes of the various buildings, said:

There are connected with the works five engines with total of 28,800 square feet of surface, which represents 760 horse-power capacity, making a grand total of 570,980 square feet of works.

We suppose there must be some sort of a diagram or key to accompany that statement, but not having one at hand we are unable to explain it.

## Modern Locomotive Construction.

BY J. G. A. MEYER.

SEVENTY-SEVENTH PAPER.

*Side rod straps for consolidation engines.* Fig. 448 represents the wheel base for a consolidation engine. Here we have four wheels connected on each side of the engine. The wheel marked *A* is one of the first pair of drivers, *B* one of the second pair, *C* one of the third pair, and *D* one of the rear or fourth pair of drivers. In some of this class of engines the main rods are connected to the second pair of drivers. The front side rod *E*, the central side rod *F*, and the rear side rod *G*, and also the main rod *M*, are represented by their center lines only.

In this class of engines the equalizing levers are arranged, like in the former class, to throw, as near as possible, an equal amount of weight on each driver; hence for the purpose of designing the side rod straps we may again assume that all drivers have to bear an equal amount of weight; we may also assume, as in the former cases, that the whole steam pressure on the piston is utilized for rotating the wheels. Since four wheels are connected on each side of the engine, it will require, under the foregoing assumptions, one-fourth of the total steam pressure on the piston to turn each wheel.

When the wheels are connected, as shown in Fig. 448, the front side rod *E* will have to transmit motion to one wheel; that is, the wheel *A*; the central side rod *F* will have to transmit motion to the second wheel *B*, and by a little reflection it will be seen that the same side rod *F* has also to transmit motion, through the front rod *E*, to the front wheel *A*. We may therefore say that the work performed by the central side rod *F* is equal to twice that performed by the front rod *E*, and conclude that under our assumptions the tensile force acting on the side rod *F*, due to the steam pressure on the piston, is equal to one-half of the total maximum pressure on the piston; and that the tensile force acting on the front side rod *E* is equal to one-fourth of the total maximum steam pressure on the piston. Such conclusion will be correct so long as the engine is in first-class condition, and running over a perfect and straight road. But when the engine is running over curves, and the road-bed is not perfect, and the wear has caused play between the axle-boxes and the wedges, the ratio between the tensile forces acting on the central and front side rod will not be exactly as two to one.

Again, since the action at one end of the central side rod is equal to the reaction at the other end, we conclude, and correctly, too, that the straps on this rod should be of equal dimensions. Furthermore, practice has shown that the stress on the front and rear side rods is somewhat less than that on the central rod. The thickness *g* (Fig. 449), of the side rod straps, obtained by the following rules, will agree with modern practice.

Rule 58. To find the thickness at *g* (Fig. 449), for the front and rear side rod straps, for consolidation engines. Divide the total maximum steam pressure on the piston by 33,600; divide the quotient thus obtained by the width of the strap minus the diameter of the bolt through it; add $\frac{7}{16}$ of an inch to the last quotient; the sum will be the required thickness.

Rule 59. For finding the thickness of the central side rod straps, divide the total maximum steam pressure on the piston by 33,600; divide this quotient by the width of the strap, minus the diameter of the bolt through it, and add $\frac{8}{8}$ of an inch to the last quotient; the sum will be the required thickness at *g* (Fig. 449).

*Example* 92. What should be the thickness of the side rod straps for a consolidation engine having cylinders 20 inches diameter? Maximum steam pressure on the piston 120 pounds. The width of the central side rod straps, and also the width of the front and rear side rod straps, is $2\frac{1}{2}$ inches; the diameter of the bolts through the central side rod is $1\frac{1}{8}$ inch; the diameter of the bolts through the front and rear straps is 1 inch.

The area of a piston 20 inches in diameter is 314.16 square inches. The total maximum steam pressure on the piston will be

$$314.16 \times 120 = 37699.20 \text{ pounds,}$$

and

$$\frac{37699.20}{33600} = 1.122.$$

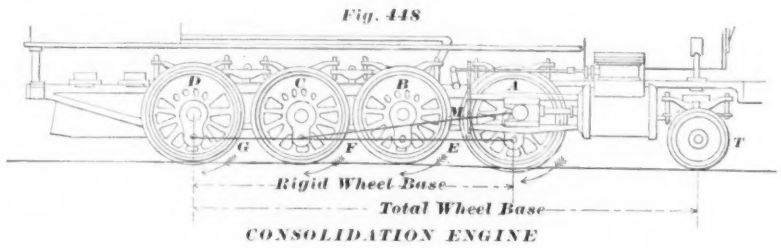



*Fig. 448*

CONSOLIDATION ENGINE

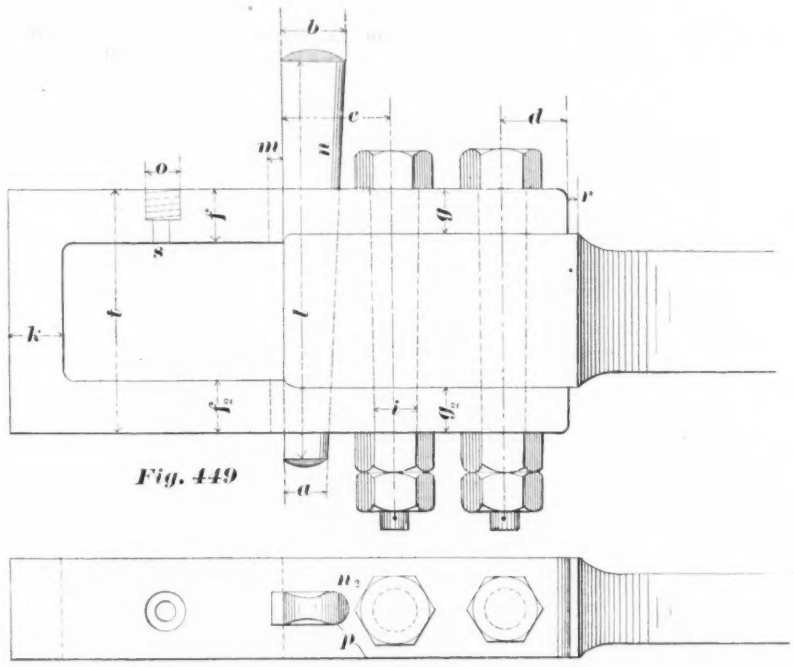



*Fig. 449*

*Fig. 450*

MODERN LOCOMOTIVE CONSTRUCTION.

The thickness at *g* for the front and side rod straps will be equal to

$$\frac{1.122}{2\frac{1}{2} - 1} + \frac{7}{16} = .748 + \frac{7}{16} = 1\frac{3}{16} \text{ inch,}$$

very nearly.

The thickness for the central side rod straps will be

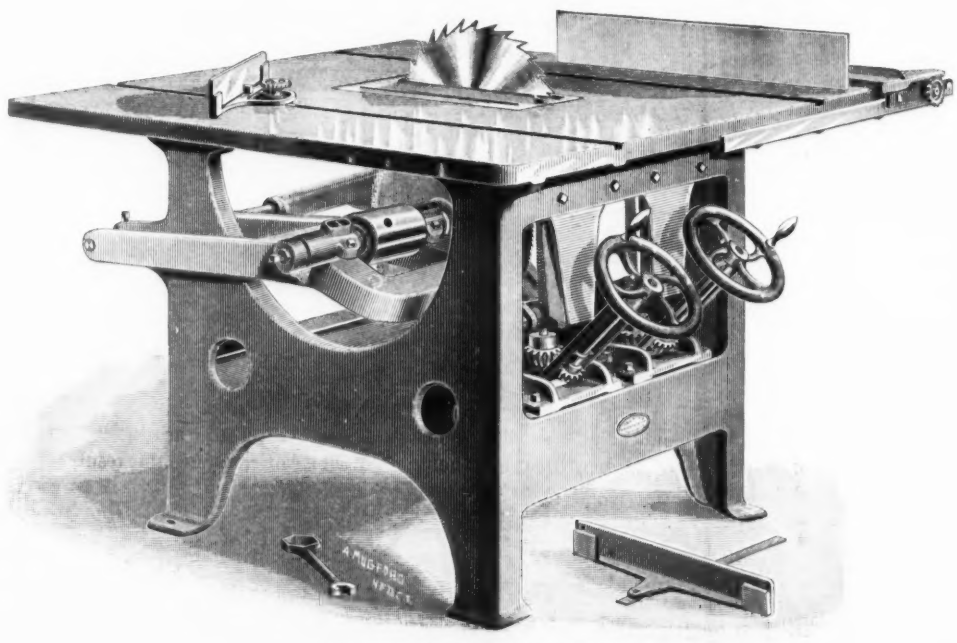
$$\frac{1.122}{2\frac{1}{2} - 1\frac{1}{8}} + \frac{7}{8} = .816 + \frac{6}{8} = 1\frac{7}{16} \text{ inch,}$$

very nearly.

After the thickness at *g*, Fig. 449, for the side rod straps, has been obtained, we determine the thickness at *f* and *k* in a manner similar to that adopted for finding these thicknesses for the main rod straps, namely, the thickness at *f* is made $\frac{1}{8}$ of an inch greater than at *g*; and the thickness at *k* is made $\frac{1}{4}$ of an inch thicker than at *g* for small engines, and from $\frac{5}{8}$ to $\frac{1}{2}$ inch greater for large engines. In some straps we find the hole *o* for the oil cup drilled through the whole thickness of the strap; in others, we find this hole only drilled part way through the wing, and then a smaller hole *s* about $\frac{5}{8}$ of an inch in diameter drilled through the remaining part of the thickness, as shown in Fig. 449. The latter we believe to be the best practice, as this will not reduce the strength of the strap as much as when the large hole is drilled clear through the thickness.

## Pattern Makers' Saw Bench.

The machine illustrated herewith is made by Frank H. Clement, Rochester, N. Y. It is a double bench, carrying a rip and cross-cut saw, side by side, on separate arbors, either of which can be raised or lowered by the adjusting screws shown.



PATTERN MAKERS' SAW BENCH.

The frame is of iron, cast in one piece; it has a large central throat, giving easy access to both saws. The slitting gauge is clamped to a way outside the table, and is accurately stopped for square or miter. The arbor frames are stayed at both ends, and the arbors have screw adjustment endwise. Altogether the machine appears to be substantial and convenient.

## Fair of the American Institute.

At this writing, this fair is in its third week, and may therefore be considered fairly under way. Those who visit it in the expectation of seeing much in the way of mechanical exhibits will be disappointed. Not that there are not some good exhibits, but that there are very few of them.

In steam engines the number is smaller than we recollect to have ever seen before. The main line of shafting is driven by a Whitehill-Corliss, built by the Newburgh (N. Y.) Steam Engine Works. This engine is 22″×48″, and runs at about 70 revolutions per minute. The workmanship appears to be excellent, and its smooth running is much admired.

Cooke & Company, New York, exhibit an $8\frac{1}{2}$″×10″ Beck automatic engine, running at 320 revolutions per minute, driving a dynamo. This engine runs substantially without noise, and attracts a good deal of attention. This firm also exhibit hand machinery for screws and bolts, and the Dodge split wood pulley.

A. C. Manning & Co., New York, show the Otto gas engine in a variety of sizes; also an engine and pump combined. As usual, these engines perform excellently. This firm also exhibit the Tangye gas hammer.

The Baldwin gas engine is on exhibition driving dynamos, as recommended for small plants, as in private residences.

There are one or two other exhibitors of gas engines of small power.

Timothy Kieley, New York, exhibits return steam traps, pump governors, damper regulators, etc.

Hine & Robertson, New York, show "Eureka" packing, pressure and damper regulators, and other appliances, amongst which is Hine's "eliminator," for removing grease from exhaust steam. This is shown in operation, and appears to perform its work admirably.

In machine tools, E. Gould & Eberhardt, Newark, N. J., exhibit upright drills, shapers, tool grinders, presses, automatic gear cutters, etc.

E. E. Garvin & Co., New York, show planers for electrotypes, milling machines, multiple spindle drills, foot lathes, hand lathes, tapping machines and screw machines. Gould & Eberhardt, and E. E. Garvin & Co., with W. F. & John Barnes Co., who exhibit foot lathes in a variety of sizes, and also foot sawing machines, are the only exhibitors of machine tools. Their exhibits, though not large, are good.

Bradley & Co., of Syracuse, N. Y., exhibit cushioned power hammers; they have also in their exhibit a wagon, all the iron-work of which was forged with one of these hammers.

The Hall Steam Pump Co., New York, exhibit a duplex steam pump.

Copeland & Bacon, New York, show hoisting engines and hoisting machinery.

A. Aller, New York, shows condensers, injectors, exhaust heads, steam traps, etc.

James Brandon, New York, exhibits his balanced piston packing.

D. DeKremen & Co. exhibit the St. John self-adjusting piston packing, for which they are prepared to give high guarantees.

The D. Frisbie Co., New York, show hoisting machinery, particularly an elevator in operation, which works admirably.

One of the very best exhibits is that of T. Shriver & Co., New York. This company show a line of unfinished iron castings, around which a mechanic is likely to linger. These castings are remarkable for their smoothness, and for the perfection with which every detail—such as letters, fine scrolls, etc., is brought out. The cored work is also a model in its way. Their exhibit represents a

large variety of small and medium sized castings, and shows to perfection the skill of the moulder. This firm also show finished piano frames, letter presses, hoisting machines, etc.

## Shop Construction.

By C. J. H. Woodbury.

The late Henry R. Worthington once made a very wise remark in answer to a certain criticism regarding some hydraulic apparatus, stating that "it sometimes cost more to stop a leak than the measure of the loss due to the leak." And the editorial in the American Machinist, of August 11, advocating the erection of fire-proof machine shops, which should not have a need of insurance, appeared to be an instance wherein the cost of stopping the leak was greater than the loss due to the leak.

Assuming that a fire-proof machine shop could be constructed, would not its expense be so great that the interest on the additional cost would exceed the annual insurance premium which it is designed to displace? And secondly, what methods of construction would be adopted to produce a fire-proof building—one of a type which has never been known to become injured by fire? I venture to say that it would indeed be difficult to find such a building in this country, regardless of expense.

Roofs are especially combustible, and iron work in buildings, although incombustible, is nevertheless subject to excessive damage in case of fire. A certain machine shop was once built with a view to constructing it so that the fire hazard would be very much reduced; the floors were laid on I beams, which were supported by columns made up of wrought-iron segments by one of the large bridge companies.

The contents of a barrel of rubbish taking fire by spontaneous combustion, warmed one of the columns near which it was standing, and weakened it to such an extent that it crippled and let a portion of the broken floor below right into the small fire, which rapidly spread, while the other columns, receiving the unusual load, in turn crippled, and the interior of the building fell down before it was burned.

Works built in cities upon expensive land must, in order to reduce the proportion of ground rent, be carried to a height above what would be considered advisable by reason of good engineering principles, light, or any other conditions except the arbitrary one of the value of the land. Some establishments have erected one-story shops upon cheap land with the most successful results in respect to light, rapidity of production, cost of handling and supervising the work, and expense of building.

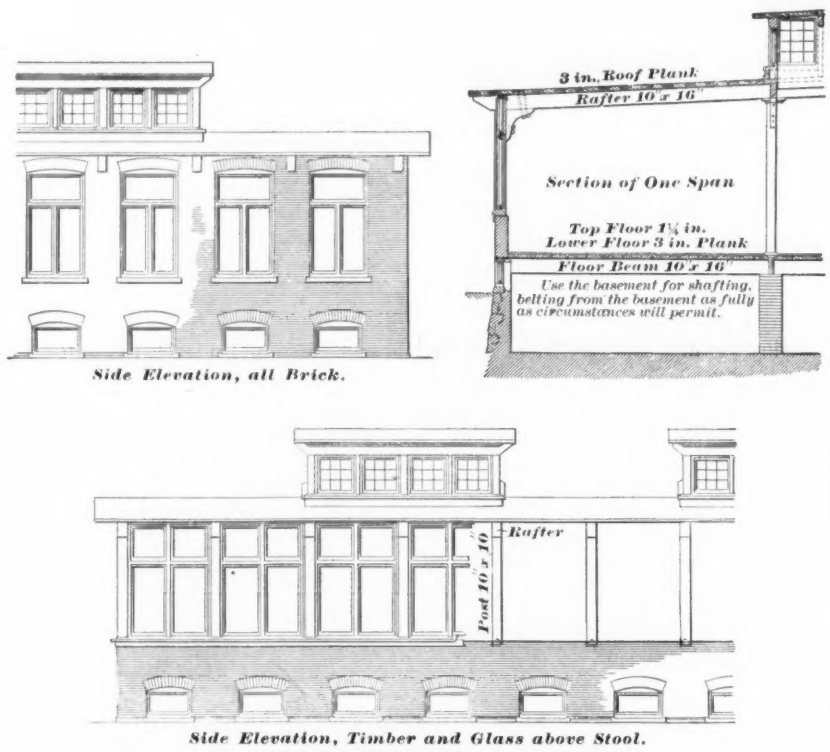
Such establishments have been made of a width not exceeding eighty feet, with two rows of square timber columns running along the shop about one-third of its width from each wall, and reaching to a height of eight feet above the walls, in order that it should project sufficiently above the flat roof extending from the eaves, to accommodate the windows there, which are of great assistance both in giving and diffusing light and ventilation. The two rows of posts on the inside afforded a good space for a traveling crane, and on the other sides an opportunity to place the two lines of shafting which drive the shop machinery.

In many lines of manufacture it is preferable to place the shafting on pillow blocks resting on piers in the basement, but this does not apply to machine shops.

The walls of such a shop could be either of brick with a great many windows placed close together, or made of brick to the window sills, and above that, windows reaching to the eaves, and separated only by timbers eight inches square, the sill of this frame resting upon the top of the brickwork.

In other places where so much window space is not necessary, the walls between the upright timbers are covered with plank three inches in thickness. The side roofs are made of two-inch plank, covered by one-inch sheathing and sloping half an inch to the foot, and laid upon beams ranging eight by sixteen inches to five by ten inches, according to the length of span and distance between beams, reaching from the wall to the pillars which extend above this roof to form the monitor. There is no absolute need of coping for such a building, beyond what might be furnished by jacking out the bricks in steps or any manner which may suit the taste of the builder. But if eaves are desirable, the roof timbers could project over the walls and their ends cut in an ogee, giving them the simulations of brackets, which support the roof plank. The roof monitor is similar to that of the side roofs. Gutters are a trouble and continual expense on all roofs, and in most shop roofs can be avoided, if the ground around the building is covered by concrete.

This method of construction is light, convenient, and solid, and wherever it has been put into use all the results have been most commendatory; and, in accordance with the theme of this article, the fire risk of such property is so slight that underwriters are giving it the lowest rates accorded to any industrial property. In fact, the net annual cost of such insurance, in some instances known to the writer, is less than twenty cents for every one hundred dollars, or one-fifth of one per cent.


3 in. Roof Plank
Rafter 10" x 16"
Section of One Span
Top Floor 1¼ in.
Lower Floor 3 in. Plank
Floor Beam 10 x 16
Use the basement for shafting, belting from the basement as fully as circumstances will permit.
Side Elevation, all Brick.
Rafter
Post 10" x 16"
Side Elevation, Timber and Glass above Stool.
If more light is desired the basement windows may be larger.

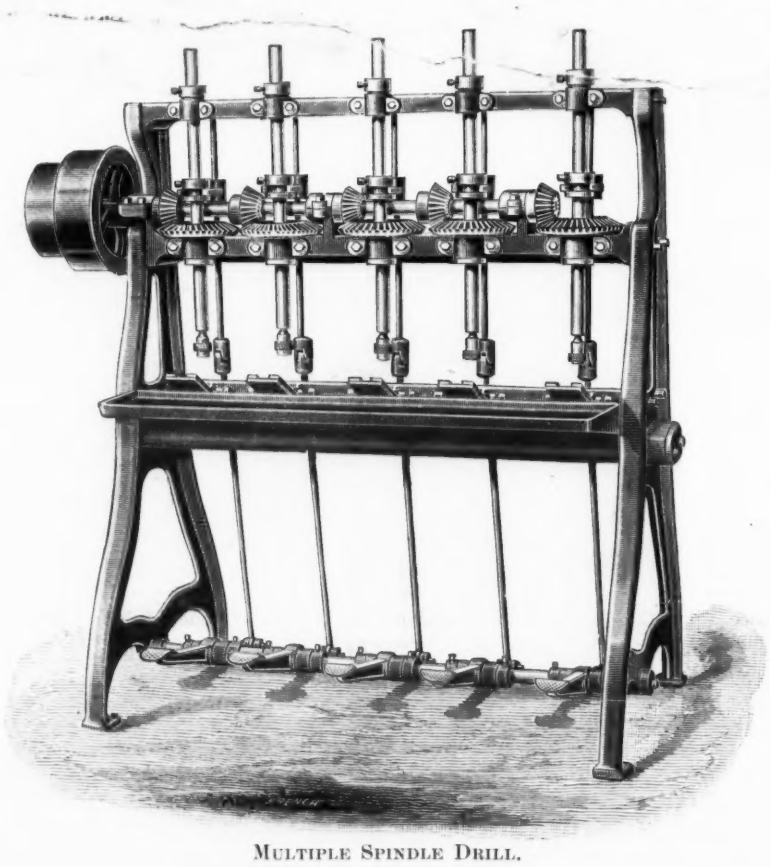
Shop Construction.

But it should be added that even this small hazard of fire is met by a suitable water supply, with hydrant service and automatic sprinklers where needed. There are a large number of automatic sprinklers put upon the market which have not sufficient claims to probability of positive and efficient action to warrant confidence in their ability to defend property against fire; but there are nearly a dozen types, any one of which has proved its practical value in a great many instances.

One of these, in particular, shows over three hundred instances, by name, date, and amount, of fires occurring on property protected by this apparatus, and in the great majority of instances no claim was made upon the underwriters; in other cases the claims were small.

I believe that it can be safely stated, without contradiction, that there has not yet been an instance where a totally destructive fire has occurred on property equipped with automatic sprinklers, which were suitably provided with a constant supply of water.

The whole experience of the matter of protection against fire, and methods of construction which will reduce the probable measure of any fire hazard, has shown that it is far cheaper to take proper measures to prevent a fire than to pay the loss, and these acts of prevention do not consist of the attempts at making fire-proof buildings, or elaborate fire apparatus, both of which may prove to be disappointments, but in maintaining orderly shops, free from neglected waste and other insidious hazards of fire, and the use of buildings of slow burning construction, in which the cost is low enough to keep the rental charges at a reasonable figure.



Multiple Spindle Drill.

## The Ram of the "San Francisco."

The ram for the "San Francisco" was cast at the Pacific Rolling Mills, San Francisco, last month. A pit, shaped like the letter L, was dug in the floor of the foundry. It was 8 feet deep, 20 feet long in one direction, and 25 in the other. In this pit was placed the mould. To this pit there was a tramway, upon which the ladle, being mounted on wheels, traveled. When the pit was reached the metal was allowed to flow into the mould in a stream six inches in diameter. When the mould was filled there was still considerable of the liquid steel left in the ladle. The actual operation of casting the ram occupied but twenty seconds. To insure the complete filling of the mould there were placed two apertures, 18x24 inches in diameter, and 4 feet long, called "rising heads," left in the top of the mould, into which the metal rises, and as the metal cools this allows for any shrinkage in the body of the metal. The weight of these two rising heads will approximate 9,500 pounds, the weight of the ram being 13,000 pounds—2,000 pounds heavier than that of the "Charleston."

The general shape of the ram is that of a crescent, with one point a little shorter and more curved than the other. The shorter point will extend upward at the bow, and the lower point will run aft under the ship. The curve forms the ram. When in position it will be 20 feet 8 inches from its most forward point to the end of the longer point, and will have a height of 13 feet 10 inches. Where the curve is the thickest—that is, where the vessel would strike when ramming—there is a thickness of 2 feet 9 inches of solid steel.—*Pacific Contractor.*

## Multiple Spindle Upright Tapping Machine.

The accompanying illustration represents a line of upright tapping machines, being built by the National Machinery Co., of Tiffin, Ohio. In these machines quarter twist belts, driving the spindles, are dispensed with, and a shaft, driven by a single belt, substituted, motion from which is communicated to the spindles by means of skew-bevel gears. As the cut shows, the gears are placed between the bearings on the spindles, and as close to the work as possible. Above the gears on each spindle is a grooved collar, by which, in connection with a fork and the treadles shown, any spindle may be brought down by a motion of the foot. The spindles can be balanced by a device not shown in the cut. The pan is made deep, to give room for oil or water and chips. The nut-holders are cast in one piece, and placed in recesses in the pan; thus leaving the entire space below clear for chips, which may be easily removed by the use of a scraper after running off the oil or water through a cock in the projection of the pan at the right. The hand-plate shown upon this projection is removed, to facilitate the removal of the chips, and enables the machine to be cleaned much more quickly and conveniently than it can be where the chips must be got out over the edge of the pan. The treadle supports are upon the machine itself, instead of being placed upon the floor, as formerly. The spindles are fitted with Morse taper holes for the sockets, thus doing away with set screws for holding them, with their attendant danger to the operator, and burring of the tap-holders. The nut-holders are of new design and easily replaced. A full line of these machines is made, having 3 to 6 spindles, each machine having a range enabling taps from ¼″ to ⅝″ to be tapped.

It is said that shipbuilding on the Clyde is better than for years.

## Force in the Steam Engine and its Relation to Smooth Running.

BY PROF. JOSEPH E. TORREY.

FOURTH PAPER.

The problem we have to solve in this paper is to determine, with the aid of the principles set forth in the last paper, how the inertia varies at different points in the stroke. To determine the amount of inertia at every point in the stroke would be a very long and

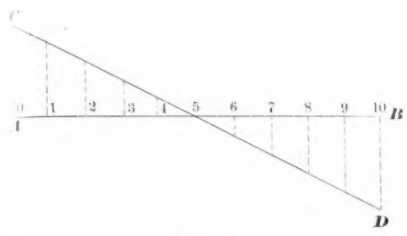



FIG. 1.

tedious operation, but we can do what will answer our purpose just as well; that is, we can divide the piston stroke into a certain number of equal parts, and determine the average inertia for each of these divisions.

Now a question arises, how shall we measure inertia? It must be remembered that, strictly speaking, inertia is not a force at all. We have seen that really, during the first part of the stroke, it is resistance to motion. In the latter part it is resistance to retardation, or stopping. In general, it is only a property of matter, an illustration of the fact that every particle of matter tends to continue in the same state in which it is. That is, if a body is at rest, it tends to remain at rest; if it is in motion, it tends to remain in motion.

Since, then, inertia is merely *resistance*, to motion in one case, and to being brought to rest in the other, we may measure the *amount* of resistance, or *inertia*, by *the amount* of force required to overcome it.

Now, if the crank movement did not play the mischief with the piston motion, as it does, this would be a very easy matter indeed. So I think we will, for the present, throw the connecting rod length out of consideration altogether, and study the distribution of inertia under these circumstances. This will give us a regular piston motion, and the same piston speed at both ends. Afterwards we will consider the irregularities introduced by the connecting rod. First, it is an easy matter to find the amount of inertia at each end, having reciprocating parts of a certain weight, as will be explained, and this amount will be the same for one end as for the other. Now how shall we find the amount for points lying between these two extremes?

In order to help keep things clearly in mind and study this point to the best advantage, we will make use of Figure 1. In that figure let us suppose *A B* to represent the length of stroke, and represent force by lines drawn perpendicular to *A B*. We can adopt some scale in which say $\frac{1}{16}$" will = 5 lbs Then a line $\frac{1}{2}$" high will represent 40 lbs., etc. Now let us represent inertia force which is *resistance to motion*, by lines drawn *above* the line *A B*, and that which is resistance to retardation, or stopping, by lines drawn *below* the stroke line *A B*. We have seen that the force required to impart the required motion to the reciprocating parts would be the same at both ends (disregarding the length of connecting rod). We could find the amount of this force by multiplying the weight of the reciprocating parts by the required velocity in feet per second, and lay off this force according to our scale on the line *A C*. Then we could lay off the same force on the line *B D*.

Now as to the distribution of force between these two points: Remembering that we are regarding the length of the connecting rod as infinite, or rather leaving it out of consideration altogether, it will be seen that the reciprocating parts would, in this case, be stationary at the beginning of the stroke, and that they would increase their velocity uniformly till mid-stroke, where their velocity would be at its greatest. From that point on they would *decrease* their velocity uniformly till the end of the stroke. Now, how can we represent this on our diagram? We have the forces at the end of the stroke laid off, and at the middle of the stroke there is evidently *no inertia force*, because during the first half of the stroke the inertia force is *resistance to motion*, and for the last half it is *resistance to stopping*, and evidently there must be a point where there is neither resistance to being moved nor to being stopped, and that point will evidently be mid-stroke, for there the speed of the reciprocating parts will be *just the same as that of the crank* (since their motions are theoretically parallel at that point).

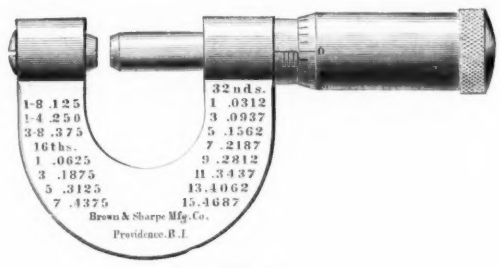
I hope I have succeeded in making this clear. It has necessitated considerable repetition, and probably considerable matter that will seem so simple as to be out of place, but I know it is *not* simple. It involves a great many ideas that the ordinary run of a stationary engineer's life never suggests. Not one engineer in fifty has ever given a thought to the subject, and as for any systematic study of the subject, it is almost unheard of among those to whom it can be of the most service, and who are in the best situations to study the matter intelligently and effectually.

We have seen, then, that there is no inertia at mid-stroke, and since the speed of the reciprocating parts is *increasing* from the beginning to mid-stroke, it follows that their resistance to motion will be decreasing at the same rate; that is, the inertia will be decreasing *uniformly*. Referring now to our diagram, we can express this by selecting a certain number of points in the stroke, say *five*, numbered 0, 1, 2, 3 and 4, and laying off amounts of force on them, by our scale, decreasing regularly from the force *A C*, which we can calculate, to no force at all, at 5. After passing 5 the retardation or slowing down of the reciprocating parts will begin, at first gradually, but constantly increasing. Accordingly, the resistance to being stopped will begin at the same instant and increase as the velocity decreases. We may therefore represent this fact by drawing lines downward from the points 6, 7, 8, 9 and 10, and laying off forces on them which shall increase regularly from nothing at 5, to the force *B D*, which we have calculated. Having done this, we may draw a line *C D* through the ends of these force lines, and this line will represent truly and accurately the fall and rise of the inertia force during the stroke. We will call this the *inertia line*. Remember, all we have done so far is only true when the connecting rod length is left out of the question. In the next paper we will see how the shape of our inertia line, and the distribution of inertia, are modified by the *angularity*, as it is termed, of the connecting rod in steam engines as actually built.

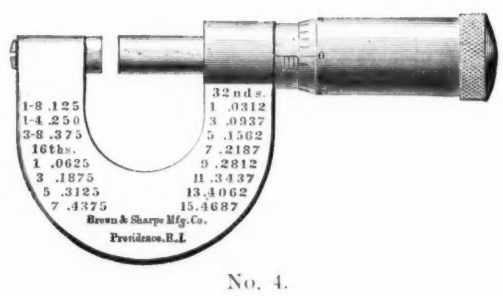
## New Micrometer Calipers.

As those having the Brown & Sharpe Mfg. Co.'s latest catalogue will perceive, they have abandoned the old classification of their micrometer calipers, and now designate them entirely by numbers. They have at the same time added to the list quite a number of new designs, some types of which we illustrate herewith.

No. 16 is a caliper having all the latest improvements, including covered screw,




No. 2.

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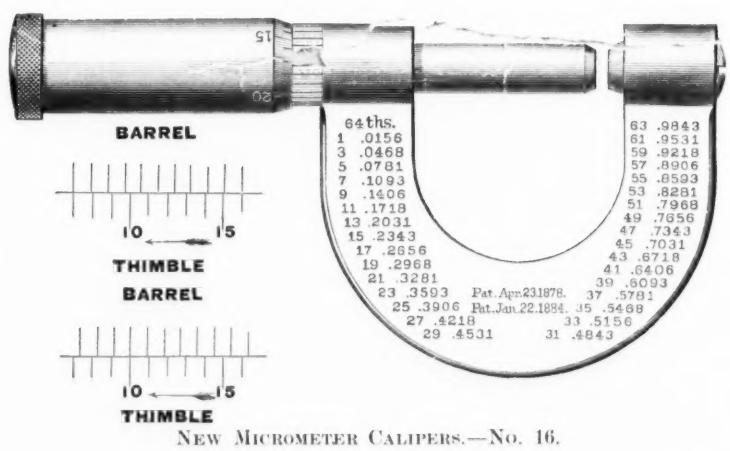



NEW MICROMETER CALIPERS.—No. 16.

table of decimal equivalents stamped on the frame, means of adjustment for wear, etc., the special feature being the combination of the vernier and micrometer principles, to make the caliper read to ten-thousandths of an inch. The way in which this is done is clearly shown by the cut. The beveled edge of the thimble is graduated in the usual manner; but the barrel, instead of being provided with the usual single line, has ten divisions, which occupy the same space as nine divisions on the thimble; consequently, when any given line on the thimble coincides with a line on the barrel, the next two lines to the right will not match, by one-tenth of a division, which is one-tenth of one-thousandth of an inch; and, consequently, to make these lines match, the screw must be moved that distance.

The arrangement is simple, easily understood, and in no way interferes with or changes the method of ordinary reading for thousandths.

The makers do not recommend that such calipers be used for ordinary measurements not requiring unusual accuracy, since in instruments of this class an amount of wear is perceptible and important, which would be of slight importance, and indeed, scarcely noticed in a caliper reading to thousandths only. What is known as the No. 15 micrometer caliper is the same as above, except that it reads to thousandths only, while No. 17 reads to ten-thousandths, and has in addition a clamp screw by which the caliper can be fixed and held at any desired size.

No. 2 is a caliper measuring up to one-half inch only, but otherwise is the same as No. 15, and No. 3 is the same as No. 2, except that it has the vernier for fine measurements, the same as No. 16. No. 4 is the same as No. 2, except that the outer end of the frame is made the same size as the gauge screw spindle, and the edges of the measuring surfaces are not beveled, but are left square. This makes it more convenient for certain classes of work. It will gauge under a shoulder, or will measure a small projection on a plain surface. No. 5 is the same, but is made to read to ten-thousandths. The full list of micrometer calipers now made by this firm includes fifteen varieties.

## Movements of the Washington Monument.

Great care is taken to note the movements of the Washington Monument, for it does move. The law of contraction and expansion of material by heat and cold operates here as well as elsewhere. When the sun shines full on the eastern face in the morning, the stones on that side expand and throw the shaft slightly to the west. Then the sun goes around to the south, and the apex of the monument makes a corresponding swing to the north. As the orb creeps about the sky to its final setting in the evening, the glittering point on top of the monument makes a contra-movement around half a circle, gradually settling back to its normal position after the rays of the sun have lost their power. This movement has never been calculated, but is undoubtedly very slight. The wind, too, has an effect upon the structure. From the center of gravity of the shaft, located 174 feet and 10 inches from the floor, is a cross-beam from which is suspended a fine steel wire, protected by a galvanized iron tube about four inches in diameter. This hangs to the floor at the northwest corner of the elevator well. At the bottom is a plumb-bob weighing twenty-five pounds, suspended by means of the wire, and hanging in water. An iron cylinder protects the instrument from injury, and a little iron house about four feet high keeps off the draught. Through the cylinder is a telescopic eyepiece, in one end of which are two vertical wires about one-quarter of an inch apart. When a candle is held at an opening in the side of the box, and the eye is applied to the outside end of the tube, the plumb line can be seen—a fine line between the vertical marks. Any movement in the shaft is recorded by a corresponding movement in the line. When the structure is at rest, and in its normal position, the line hangs still, midway between the others, but when the shaft is disturbed by the action of the wind it sways back and forth like the pendulum of a clock, always coming to rest in the center. This is observed every day, and if the custodian should ever notice the line hanging still at any point outside of the two cross lines, he will then know that the monument has been permanently moved from its level position. Until then, however, no one need be alarmed by the oscillations of the shaft from the action of the wind or the influence of the sun.—*Washington Star.*

## LETTERS FROM PRACTICAL MEN.

### Cleaning Boiler Tubes.

*Editor American Machinist:*

I have often watched the process of cleaning the lime or scale from old boiler tubes, or tubes that have been taken out of boilers, and are good to use in a shorter boiler. I have heard the workmen declare that their wages would buy new tubes, and more too, and I have always thought they were in the right of it.

Some of the devices I have seen used for

the purpose seemed to have the merit of ingenuity, but no device that I ever saw would clean the tubes thoroughly. Some set up two half-round files in the form of the letter V, and draw the tubes through back and forth, and in this way *partly* clean them. Some have a large tumbling barrel, and tumble the tubes until they are clean. This is a good way, but few can have access to a large tumbling barrel, and of course must resort to other methods. Now I am poor, and also lazy, and am opposed to hard work when I can avoid it. I have a small boiler, 30″ shell, 4 ft. 6in. high; both heads and all the tubes played out, and I had to build it all new but the outer shell.

I made a pattern and had two heads cast. The flue holes were cast for thirty-one 3″ tubes. After riveting the heads in and calking the shell down to the heads tight, I began to think of tubes; thirty-one tubes, 4 ft. 6 in. long, 3 in. diameter, would cost quite a sum, and a poor man don't like to spend *too* much money when he can help it. I went down to one of the paper mills and bought eighteen tubes that had been used in their boilers. These tubes were nearly 12 ft. long, so I could get two tubes out of each, and good ones at that. I gave three dollars for the lot, and then commenced the fun of cleaning the scale off. I first cut them in proper lengths with a hack saw, then wet them with vitriol and water; but this only seemed to stick the scale tighter. I then tried the files set V shape, but found I could not scrape them clean. I had just about given up in despair, when I thought of an experiment suggested by some knowledge of chemistry. Try heat. I first thought of building a large wood fire arcund the tubes, and heating them that way, then I saw that would not do, as some would warp and bend by their own weight when hot. So I took them into the blacksmith shop and heated to a good generous red, and kept shoving the tube through the fire until it was heated and annealed more than half its length. Then I laid it down and took another. When all had gone through this process I commenced the other end and finished the heating process thewhole length. Most of the lime seemed to be on them yet, but its nature had changed; instead of the scale being hard and clay-colored, it was a beautiful white, like air-slacked lime, and I could wash it all off down to the clear iron, with water and a broom. The whole cost was not more than two cents a foot, and the tubes were soft and in good shape to expand and bend.

If this will help some poor fellow out who has a lot of tubes to scale, he is welcome, as I have not taken out a patent on the process.

Penn Yan, N. Y. LEROY TOBEY.

### Chordal's Code.

*Editor American Machinist:*

The article, "How to Reduce Drawing-Room Expenses," by Mr. Rogers, in the AMERICAN MACHINIST of Oct. 6th, and the criticism of it, Oct. 20th, by Mr. Huson, tend to produce in the mind of the reader who has not been otherwise informed, a very poor impression of Chordal's judgment in the matter of drawings and their use in the shop. Chordal is pre-eminently an experienced mechanic, and has done more toward causing mechanics to read and think for themselves than any contributor to the AMERICAN MACHINIST, as is proven by the fact that he is referred to more frequently than any other contributor, although he has written scarcely anything for six years.

In the preface to Extracts from Chordal's Letters, published in book form in 1880—six years before Mr. Rogers discovered that he had used a system—he writes as follows: "They were without continued thought on any one subject, being intended as the presentation of the topic, rather than the thought."

"With such intentions, it made little difference which side of a question was taken, or that an opposite side was taken in a succeeding letter."

"There is but little need of consistency, where there is no tenacity of view."

In Chapter XXXV of the book is the following: "The machine shop drawing is simply a memorandum, showing what is to be produced. It is essentially an illustrated memorandum, or it would be no drawing. To be perfect, it should answer all questions which a workman can reasonably ask in regard to a piece of work; it should be durable enough to form a record for future use; it should be small enough to be easily preserved in a safe place, and it should be as low in cost as possible."

To summarize, the system advocated by Chordal is about as follows:

It is intended only to be used in shops where the product is a regular line of machinery in quantities. Symbols are used in place of names, to save clerical work in keeping cost accounts, and because it would be impossible to mark the small castings with the name of the machine to which they belong, and some ready means of identifying them is absolutely necessary.

The drawing for the first machine is made full size if practicable, and all important dimensions figured, but it is made on common paper for temporary use. A symbol is adopted, and is put on these drawings and the patterns. A machine is built from these drawings, corrections are made, the details approved, and then permanent drawings are made on standard sized cards 10x13½ inches, for shop use; drawings as plain as possible, no shading and as few sections as possible to show the parts. All dimensions needed in the shop, and only those needed, to be given in figures; figures not to be repeated on different views of same piece. Parts to be finished to no particular dimension; marked, "polish," or "plane" or "face."

Now as to the "Code."

The instructions to pattern maker are only needed when he is required to make a pattern from one of these shop drawings, which occurs but seldom. He is cautioned to make his own allowance for shrinkage and draft, because in some places it is the practice to make drawings for the pattern maker in which the draftsman has made allowance for shrinkage. "Holes with no size given are to be cored to size," does not mean the hole has no size, but means he is to measure the drawing, and core the hole to that size.

Of the instructions to machinists, Mr. Huson says: "It must indeed be a poor mechanic who does not do every one of the instructions by intuition." He must remember that poor machinists and apprentices should learn these things, and it would not spoil a good mechanic if he happened to read them over. For further information, I respectfully refer Mr. R. and Mr. H. to the AMERICAN MACHINIST of Sept. 11th and 18th, 1880, and Sept. 10th, 1881, where Chordal has fully explained the system he advocated.

B. CRANK.

### The Rights of an Inventor.

*Editor American Machinist:*

Your article, entitled "Smothered Inventions," in your issue of October 13, seems to me to be so erroneous that I trust you will permit me to state what I conceive to be the true view. You say:

"A patent is, in reality, a contract by which the people (represented by their government) agree that they will not make use of the specified invention for the term of seventeen years from the date of the patent, except upon such terms as may be agreed to by the inventor. This would seem, when carried to its logical conclusion, to involve the right of the inventor to impose such terms for the use of his invention as to practically lock it up and prevent its use during the term of the patent, whenever it seemed to him that his interests required it. But all contracts are supposed to confer benefits of some kind upon both or all the parties to them; and, it is a well settled principle of law, that a contract without consideration is void."

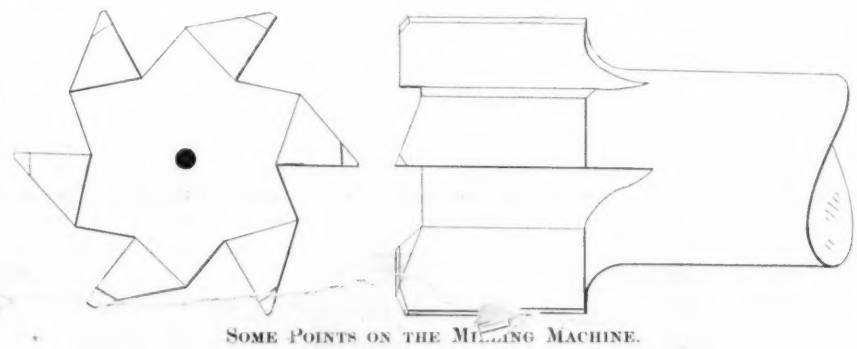
A plain inference from this is, the patent which is locked up and not given to the public is void, because the contract is without consideration. This view is at variance with the statute which is the sole authority for the existence of the patent. There is no provision or requirement in the statute that the invention shall be manufactured by the owner of the patent; nor is there any clause in the contract requiring anybody to manufacture. There *cannot* be any such restriction, because the constitution only authorizes a grant which is exclusive, and a grant with limitations would not be exclusive. The consideration required by the statute is the full and complete disclosure of the invention. The public comes into full possession immediately on the expiration of the patent, and has the fullest enjoyment of it forever. Elias Howe received from his patent several millions of dollars. He enjoyed the exclusive use for a few years, when it passed to the people, who will possess it *forever*. Supposing he had suppressed the invention during the period for which the patent was granted. The people would have entered into possession just the same, and would have enjoyed it just the same.

Supposing I lease my lot to A. B. for ten years rent free, upon condition that he build thereon a certain house, which shall become mine at the expiration of the lease. If he chooses to lock the doors and keep them locked until the expiration of his term, would anybody say that I have valid reason for complaint, or can terminate the lease? Certainly not. The patent stands on the same ground exactly; the consideration is in the disclosure, not in the use during the term of the patent. *The inventor creates the invention*, and can lock it up in his breast and carry it to the grave with him, as many have done. The people have no claim to it nor rights in it, but they want to have, and therefore they say, disclose this to us, and no one shall interfere with your exclusive use of it during a term of years; you may do as you please with it. That is the offer on the part of the people. It is in the option and discretion of the inventor whether he will accept. There is no compulsion. Many do not accept, but prefer to keep their inventions and work them in privacy. To many people, looking backward, it seems that the public would have suffered if a certain invention had not been made public. Take the sewing machine, for instance. If Howe had preferred to lock his invention up, it is easy to figure up how much *saving would not have been saved*, and we set that down to the account of loss and hardship. But when you read the account of the life of Howe, or any other inventor who gives to the world a new idea, and count in the hardship, opposition, and obloquy cast upon him before this same public would look upon him in any other light than as a sort of criminal, it is not easy to see why the inventor should be sentimentally tender of the feelings of the people.

It is a matter of business on both sides, and if the patentee finds his advantage in locking it up it is no one's affair. As a general thing, desire to make a profit causes the patentee to sell the patent or put the invention in the market; but it sometimes happens that the manufacture would involve infringement of prior rights; and the wait is therefore compulsory—ought the inventor to lose his patent on that account? And it also often happens that the patent serves only as a hedge around some more important invention.

R. D. SMITH.

[Inventors themselves we think, do comparatively little locking up of their inventions. This is oftenest done by those to whom they sell their patents, and who in some way control the business to which the invention relates. In the article referred to by Mr. Smith, we mentioned the Bell Telephone Co., and the Western Union Telegraph Co. It is such companies, having a monopoly of certain lines of business, who can successfully lock up useful inventions, because the inventor frequently can sell his invention to no one else; no one else having any opportunity to make any use of it. We believe that such companies control patents from which the public never will receive the least benefit either during the term of the patent or afterwards. It might be argued that the public is then no worse off than if the invention had never been revealed; but it is, because it has agreed to perform a valuable service for the holder of the patent, *i. e.*, to prevent, with its whole power, if need be, anyone else using that invention, even though the same thing should be invented by another, having no knowledge of the first invention.]



SOME POINTS ON THE MILLING MACHINE.

### Some Points on the Milling Machine.

*Editor American Machinist:*

Some time since my attention was directed by Mr. Wm. D. Turner, of Providence, R. I., to what might be an improvement in end milling cutters, *i. e.*, the relieving of the ends of the end teeth toward the center, to admit of greater freedom of movement of the work when sinking a slot or key-way; and I resolved to try it the next time I had to make a cutter.

In the meantime I had made a face mill, 6″ diam., with 12 inserted teeth, but after a little I found I could do more work, and in some respects better work, by taking out alternate teeth, which I did, and now have an extra set. I have never seen any reason to replace them as yet; so in making my new end mills I reasoned in this way: the trouble being to get rid of the chips, and a certain quantity of metal making about so many chips any way, but rather less in quantity if either way when cut coarse, I decided to put but six teeth in my new mill, thus leaving lots of clearance. I hardly think, however, that I should have dared to so far leave the beaten track, which would be to put 12 or 14 teeth in a mill of the size shown, had I not just about that time had my patience nearly exhausted by bother to get rid of chips. So I started out on what looked to be a rash venture; but now I have to describe the best end milling cutter I ever saw or used; a full size sketch of one I enclose to you. In turning I had the end chambered out squarely to a depth of $\frac{9}{64}$″, and to a diameter equal to the inner circle of ends of teeth. In cutting the teeth I used a 70° cutter, and cut just deep enough to come through the ring, which was left on the end of the cutter blank. The teeth were then backed off as shown, leaving only a very thin edge, and a small triangular portion of metal at the inner end of each tooth, which was chipped and filed down to the level of bottom of the chambered end of cutter blank, thus making a cutting edge on the inner end of each tooth. The cutter was then tempered very hard, and not drawn at all. The shank, although not shown, is made to fit the socket sent with the Brown & Sharpe Universal M. M., No. 3, and was ground true after hardening. This mill possesses some advantages which might be overlooked in a hasty glance. One is, the end cutters may be ground with the regular 6″ wheel, and without the trouble of rigging up, as when a mill has more teeth. I have used this cutter most in our vertical milling attachment for surface work, and have found on a special job that I could do about five times the quantity of work possible on a planer, and do it sufficiently good; but of course this was forcing matters. This cutter may be sunken directly into a surface the depth of its teeth, and will then mill its way along in any direction without any trouble.

While talking about milling machines I

will call your attention to the advantage of a handle for the gear end of the spiral bed of the B. & S. No. 3 Universal. We have had one in use nearly three years; it is clamped on the hub of gear, and being finished all over, in keeping with the rest of the machine, it looks well, and leaves the machine looking as if it had lost some vital part whenever it is taken off; and it has, too; for I use this handle about three times as much as I do the other one on one class of work. The machine was not disfigured or changed in any way to place this handle. To admit of working the feed from this end of the bed, I have removed one of the two screws holding the slotted shifting bar to its extension piece, and in its place put a simple ball of 1" diam., having a neck and screw heads to fit the same hole. This I find very handy, and although its motion is very short, by relieving the strain of feeding by the hand on handle, the feed may be easily started or stopped with this ball handle. A good thing about it is that it moves in the same relative direction as the handle at other end of the bed.

I have also procured another bracket for the oil-pot holder, which I have placed on the opposite side of machine from those as sent out by the factory, and now I never use the original one for the oil-pot, but find it quite handy for a lamp bracket. For feeding, there should have been some way provided to feed in either direction, and trip it automatically, too, and without any trouble. I get over the trouble of reversal of feed by running a very elastic belt from the spindle of the machine to the idle cone. This admits of being run either crossed or open; but although I have tried various ways to stop the feed when feeding backward, and they would do it after a fashion, I have yet to find a real good one.

Bennington, Vt. CHAS. S. BEACH.

[In our issue of January 8, 1887, there is a description and illustration of a device for automatically tripping the feed when feeding backwards, which is in use on a good many B. & S. milling machines, and is entirely satisfactory. It also serves every purpose of the ball spoken of by Mr. Beach, since it enables the feed to be thrown in or out by hand at any point along the bed.]

### Says His Pump is Misrepresented.

*Editor American Machinist:*

In your edition of July 7th, there appears an article entitled "A Wonderful Pump," professing great astonishment that "honest people will be fooled" so dreadfully, even "judges and superintendents of waterworks," etc., etc.

Now if you are curious to see something of "which you have never dreamed in your philosophy, Horatio," take a little ride to Beaver Falls, Pa., and if we don't show you that we elevate liquid without contending with a pound of the avoirdupois weight of the water, your expenses will all be paid.

The common double-acting force pump and this "new departure" are side by side, run by power, and will be proven by official instruments to your satisfaction.

I should not have written at this time, but it seems to be a duty in the interest of mechanical science.

H. M. CLOSE, Inventor.

[In our article to which exception is taken, we referred to the absurdity of the claim of saving 75 per cent. over an ordinary pump. No well-constructed pump wastes 75 per cent. of the power applied, and it is impossible to save more than is wasted. And the actual work of lifting a pound of water one foot high is just as great in the instance of one pump as another.]

### "How to Reduce Drawing-Room Expenses."

*Editor American Machinist:*

In reply to Mr. Huson's criticism of Oct. 20th, I will say in answer to his first paragraph, that having always been a busy man, so far as work is concerned, and too lazy to theorize, I have had to learn from experience, which has convinced me that the fewer figures there are on a drawing, the nearer it is to perfection. "Erring on the safe side," reminds me of a railway rule, saying, "In all cases of doubt, employes must take the safe side," *i. e.* (side track), but the doubting Thomases couldn't tell the safe side, and we always found them on the main track. By close examination of Sheet No. 1, Mr. Huson will find an error that caused the alteration of the pattern after it was ready for the foundry, caused by an anxiety to "err on the safe side," perhaps, and get it "most complete," as he remarks.

Paragraph two reminds me of a pattern-maker, who once came and meekly informed me that I had "forgotten the shrinkage and draft lines, as the other man always put 'em on." Well, as I had seen colored and dotted lines marked "draft," "shrinkage" and "finish" on drawings before, I wasn't surprised, but I did not put them on for him though, and with the code between us, we got along splendidly and I found him to be a thorough workman. My understanding of this rule of Chordal's is for the draftsman to mind his own business, very politely expressed.

Referring to the third paragraph, if Mr. Huson had read slowly and observed closely, he would see that cored holes come under Pattern Maker's Instructions, who are expected to measure everywhere, if no figures are given. If Mr. H. can dictate the exact size of a cored hole and have it show up in the casting, according to drawing, every time, his foundry has reached a state of perfection not found in the majority of places. I tried to dictate to the cupola once, and the pitying smile of the molder cured me.

"Do not measure when figures are given" is a rock-ribbed law of pattern makers, old as the hills, and as good, but perhaps Mr. Huson never changes a dimension on a drawing; and that reminds me of one time, about four years ago, visiting a drawing-room and incidentally asking a draftsman what brand of ink he used? He replied, "I rub my own ink." During my visit I noticed that he duplicated by copying, and was making a reduced drawing the old way, with rule and compass, and I suggested the use of proportional dividers for reducing and blue prints in duplicating, and will never forget his look of wisdom when he told me that he did not "expect to work himself out of a situation just yet." I also discovered that his salary was fifteen dollars a week. A few weeks since I met him, and he felt discouraged, he never could get his wages raised. But he made the job last. There is a moral here, if you can find it.

My blacksmith tells me to go right along with Chordal, as it suits him, and knowing a dozen others who are suited, I conclude that experience beats asking questions.

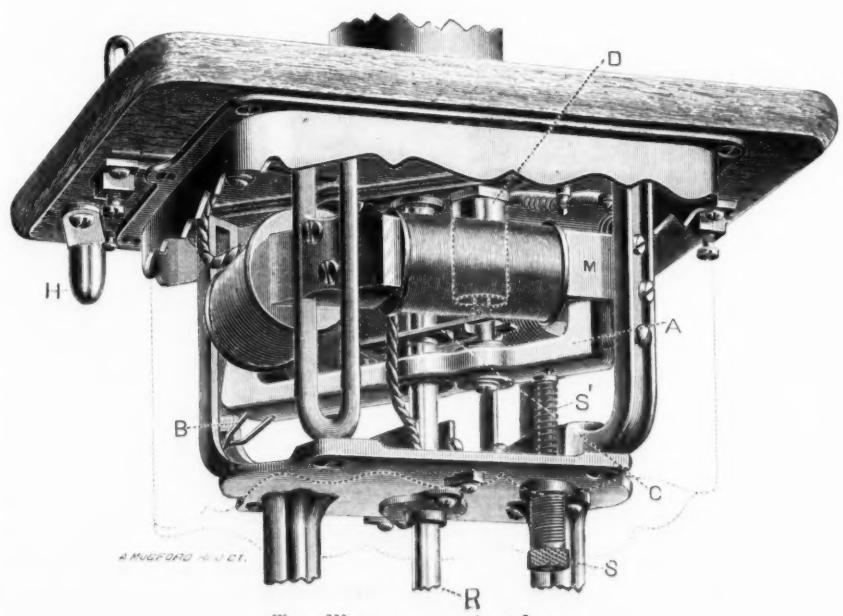
The instructions to machinists, I'll admit, are tame. That is why I like them, as I have found that such rules have converted scores of wild, poor machinists into good mechanics. Mr. Huson will notice that I make a distinction here, because I have found a difference, and my adopted code is the medicine that has tamed them down into thinkers, and raised their pay.

I can show Mr. Huson several shops full of pattern makers who will keep shoving sheet No. 1 under the pile until all the Nos. 2 and 3 are used, and the fellow that gets No. 1 calls it hard luck, especially when the boss is crowding him hard to get the job out on contract time.

I hardly expected the code would be tried, or thought worthy of it, by Mr. Huson, and gave him my reasons in my former article. In closing, I will acknowledge that my boy in the drawing-room did not "do the same work in one hour." He did better.

Snubbing the taper attachment chap was a good thing, as he is determined now to obtain a correct knowledge at any cost. I know a youngster that came direct from college two years ago and took the board next to the writer, in a drawing-room. In shop practice he was green, but he took the code for law, saw that it governed the draftsman, as well as the others, without hurting his feelings, and to-day has charge of the room. I'm bragging on that chap. He knew a good thing when he saw it, and "his hat was exactly the right size." W. S. ROGERS.

STANDARD SPRING CALIPERS.




THE WATERHOUSE ARC LAMP.

### Standard Spring Calipers.

Our engravings represent a new form of calipers, brought out by the Standard Tool Co., Athol, Mass.

The spring takes hold of pins, which are so located that, as the calipers are opened or closed, the tension, or rather the force of the spring tending to open the caliper, is practically uniform. There is a quick adjustment provided, which, by pressure upon a knurled head, releases the nut from the screw, and allows the caliper to be quickly adjusted to any required size, when, releasing the pressure, causes the nut to close automatically. Then, when the caliper is finally adjusted, a turn of the knurled head locks it, so that, even if dropped upon the floor, the adjustment cannot change. The engravings show the construction clearly. The outside calipers are made in four sizes, from 4 to 6 inches; the inside in two sizes, 5 and 6 inches.

### The Waterhouse Arc Lamp.

We illustrated a few weeks since the Waterhouse automatic regulator, manufactured by the Waterhouse Electric & Manufacturing Co., of Hartford, Conn., and now present the Waterhouse arc lamp. It is claimed for this lamp that, owing to its simplicity, fine adjustment is not required. The novelty of the invention is the lamp magnet *M*, which consists of an iron core, quadrangular in shape, having two main magnet coils and two shunt coils wound at right angles from each other. The main are represented by the coarse wired coils, and the shunt by the fine wired coils on the magnet *M*. In the magnet *M* is an elongated hole, into which the tongue of the armature *A* is drawn by the magnetism. The armature *A* is pivoted on the other side of the magnet (not shown), and is supported, when no current is passing through the lamp, by the supports *B* and the spring *S'*. The spring *S'* assists the armature, its resiliency being varied by the adjusting screw *S*. The spring *S'* prevents a sudden falling of the armature downward, and the air dash-pot *D*, which is also connected to the armature *A*, prevents a sudden upward motion of the armature. Connected also to the armature *A* is the clutch *C*, through which the carbon rod *R* passes. The poles of the shunt coils and the poles of the main magnet coils are of opposite polarity at the ends of the magnet *M*, under which the armature *A* is pivoted.

The current coming to the lamp enters at the terminals near handle *H*, passes to the main magnet coils on magnet *M*, thence to the carbon rod *R*, through the carbons, and passes out at the terminal on the opposite end of the lamp board. This produces magnetism in the poles of magnet *M*, and draws up the armature *A* into the elongated hole in magnet *M*, and away from the supports *B*, the spring *S'* assisting the armature to the proper elevation. We then have the armature free from any mechanical friction, and directly susceptible to the influences of the magnetism in the magnet *M*. The drawing up of the armature moves the clutch *C*, which lifts the carbon rod *R*, and it in turn separates the carbons and forms the arc. As the carbons burn away the resistance in the line through the main magnet coils becomes greater, owing to the separation of the carbons, than the resistance of the fine shunt coils, and a portion of the current is diverted through the shunt coils around the arc, and, as the shunt coil poles produce an opposite effect from the main coil poles on that portion of the magnet *M* under which the armature *A* is pivoted, the result is a reduction in the magnetism in magnet *M*, and by gravitation the armature *A* recedes slightly, easing up on the clutch, which in turn releases the carbon rod *R*, and the carbons feed. The feeding is so fine that the carbons retain nearly a relative position, while they slowly wear away. There is no sudden motion, and it is claimed, owing to its simplicity, that the Waterhouse lamp has a greater range of adjustment, and does not require that fine, careful adjustment usually required by arc lamps.

On the opposite side of magnet *M* is an automatic cut-out (not shown), which is adjusted to cut the lamp out on over a quarter of an inch separation of the carbons.

Great care has been taken to insulate the lamp properly, and all of the small details so necessary for a perfect working lamp have had careful attention. All current can be made to pass around the lamp by closing the handle *H*. The same form of magnet is used with the Waterhouse rack-feed lamp, and also with the double or all-night lamp.

Fine straw bagging for cotton seems to be finding favor. It looks as if a new industry was to be established in its manufacture.

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☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

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## The Decadence of Mechanics' Fairs.

This has not been a brilliant year for fairs that depend to any great extent upon mechanical displays for their success. It is doubtful if there will be any more brilliant years for such exhibitions. Sometimes, upon special occasions, like that in the instance of the Cincinnati Exposition, local pride may come to the rescue, without reference as to whether or not it pays to exhibit. But on general principles there is no doubt that manufacturers of machinery have nearly all come to the conclusion that the opportunity of a fair affords at the best an uncertain way of bringing their manufactures before those likely to become customers. It is no more than a spasmodic effort to secure attention, and results rather in satisfying the curious than in interesting prospective purchasers. Men visit fairs more as a matter of recreation and to gratify their curiosity, than to transact business of importance.

The bazaar feature of the modern fair in cities is its principal reliance. There are yet some substantial manufacturers who exhibit because it is a habit with them, but their number is comparatively small. The general expression of such manufacturers is that it does not pay as compared with other means of bringing a knowledge of what they make before the public.

With the county fair the case is different, although we believe the genuine county fair is hardly holding its own. At these fairs the social element is a controlling factor. Men scattered over large districts use the county fair as meeting ground, and the chance to meet, to see a crowd, and perhaps listen to a little oratory, is satisfactory remuneration. In the large city the social part is almost or quite lacking. It is a question of dollars and cents, and the verdict of manufacturers appears to be that it does not pay; hence the decadence, from the standpoint of the mechanic and manufacturer, of the modern fair.

## The Wheat Deal.

Bitter denunciations of Hutchinson, the Chicago wheat gambler, are to be found in almost every paper one picks up now, and he is charged with being solely responsible for the recent rise in the prices of wheat, flour, and bread.

Hutchinson is a gambler to all intents and purposes, and makes his money without returning to the community any value or service therefor.

We, as our readers well know, have little inclination to defend such as he, and yet we are forced to the conclusion that he is not justly chargable with all that has been brought against him in connection with this, his latest deal. He is reported to have made a million dollars by the operation, but it is to be remembered that he made it out of other gamblers, who were trying to beat him in the game, and did not do so, simply and only because they were not sharp enough. Of course, the million dollars originally came from those who work and produce values, but the money had been stolen from the producers before Hutchinson got hold of it. It is claimed by those familiar with the grain trade, that the principal effect of Hutchinson's deal was to make known that which was already a fact, *i. e.*, that the crop of wheat was short, and that it was being exported at too low a price. The rise in prices has almost entirely stopped the exportation of wheat, which, under the circumstances, is probably fortunate, because it was being sent out of the country at a rate which would have made it necessary before long to buy some of it back at increased prices; which, it must be admitted, would scarcely be a paying business.

It is said that such a thing has occurred twice in former years, and that wheat exported to Liverpool in the early part of the season at low prices, under the impression that there was an abundant crop, has been shipped back later, to make up deficiencies, at much higher prices.

It is not unlikely that this deal, by proving thus early in the season that there is a shortage, has actually prevented prices rising so high as they would have risen later if the shortage had been revealed after a good part of the crop had been exported, and the balance was in the hands of dealers instead of being largely in the hands of farmers, as it now is, and who will thus be enabled to get some of the benefit from it.

"Hutch" did not have the entire wheat crop cornered, but simply the supply which was available in Chicago at a certain time; that time being the day on which the other gamblers had contracted to deliver it to him. This is shown very plainly by the fact that, while "Hutch" was compelling the other gamblers to pay him two dollars per bushel for wheat with which to fill their contracts, wheat to be delivered a few days subsequent to that time was selling at little more than half that price.

The usual effect of the operations upon the floor of the Chicago Produce Exchange, is to deceive outsiders as to the true condition of the market, and thus make prices either higher or lower than natural causes and conditions would make them. This is where the wrong of the system comes in; but in this particular instance the effect seems to have been to defeat those whose interest it was to keep prices of wheat abnormally low, and to give natural causes a chance to act. We do not for a moment think of giving Hutchinson any credit for this, because of course his interest in the matter was only that of a gambler, and he had no thought of letting the truth be known for the sake of the truth, or in order that justice might be done. The whole system of gambling in the necessaries of life is wrong, and ought to be stopped; but no point is gained against the system by condemning a particular operation which seems likely to be in itself rather beneficial than otherwise.

At the commencement of the present political campaign we expressed the opinion that there was no necessity for a stagnation of business on account of it. We scarcely expected to escape some stagnation, because, as we said at the time, there would probably be enough business men looking for dull times, and acting accordingly, to cause dull times. But it gives us pleasure to note that there has been a sufficient number of business men and manufacturers holding the views expressed by us to keep business in good condition. There is now, as there always is, a few manufacturers whose business is not entirely satisfactory to them, but manufacturing interests generally are now, and have been throughout the campaign, in an unusually satisfactory condition. Most of the leading tool builders report business exceptionally good, and they are usually first to feel the effects of stagnation or lack of business confidence.

We consider the present condition of affairs a cause for congratulation, and we hope it indicates that there is an increasing proportion of men who will refuse to believe, or act as though they thought, that the country was liable to go to immediate destruction because some one else said it must.

The recent decision of the New York courts, declaring to be constitutional the law regulating grain elevator charges, strengthens the principle that in the exercise of the rights of property the public good is always to be held paramount.

Justice Brown says: "I think the law in question is valid. * * * While the general proposition is conceded, that a person living under our constitution has the right to adopt and follow such lawful business, not injurious to the community, as he chooses, yet this right is subject to the power vested in the legislature to regulate the use of all property and the conduct of all citizens toward each other, when necessary for the public good."

Mr. Ambrose Swasey, of Cleveland, Ohio, during a recent call upon us, reported business in machine tools good with his firm (Warner & Swasey), and their business of astronomical instrument making also on the increase. The great Lick telescope, recently completed by them, and which Mr. Swasey went to California to supervise the erection of, is working satisfactorily; and among their recent orders for similar instruments is one for a 12″ equatorial, with photographic apparatus, for the National Observatory at Cordova, Argentine Republic.

No one except those directly interested will fail to rejoice at the discomfiture of those parties who have been interested in cornering lead. The combination succeeded in nearly doubling the cost of lead to the consumer, but, biting off more than it could masticate, it went to pieces rather ingloriously. This ought to be the end of all other conspiracies to defraud the people.

## Literary Notes.

Our enterprising contemporary, the *Northwestern Lumberman*, is publishing a list of manufacturers of and dealers in lumber and principal timber products in all the States and Territories. These are classified by States, and made easy of reference. The list contains the names of manufacturers, what they manufacture, the kinds of timber used, daily capacity, and power used. This list will be continued from week to week till complete.

Vol. VI, No. 5, *Proceedings of the Engineers' Club, of Philadelphia*, contains, amongst other interesting papers, one by William Sellers, "On the Manufacture of Eye Bars for Pin-connected Structures," that is of interest not only in showing the manner of procedure in the manufacture of such bars, but also for bringing out the difference between the treatment of iron and steel, to bring about the best results in each instance.

# QUESTIONS AND ANSWERS.

*Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.*

*Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.*

(483) J. T., Corry, Pa., asks: How can I make copper castings which will not be full of holes or honey-combed? The castings are simply plates ¼ inch thick, from 3 to 6 inches long, and 2 inches wide. *A.*—Mix a little lead with the copper. 2. Are there any books that treat on the mixture for brass cuttings? *A.*—"Brass Founding" by James Larkin.

(484) "Reader," Brooklyn, N. Y., writes: Will you please decide this question? F. M. claims that pig iron is raw material, while R. C. claims that it is manufactured. Which is right? *A.*—It depends upon how you view the matter. Those who are engaged in the manufacture of pig-iron regard it as a finished product, and iron ore and coal as the raw materials. But to the vast majority of manufacturers using iron, pig-iron is a raw material.

(485) J. S., Newark, N. J., writes: Please inform me how to find the square feet of heating surface of a steam radiator. For instance, the radiator contains 300 feet of 1-inch pipe; what will be its heating surface in square feet? *A.*—300 feet = 3,600 inches. The outside circumference of 1-inch pipe = 4 inches. And 3,600 × 4 = 14,400 square inches of heating surface. Lastly,

$$\frac{14,400}{144} = 100$$

square feet of heating surface. The way you have calculated the heating surface is not correct, because you did not multiply the length of the pipe by the circumference.

(486) H. E. B., St. Louis, writes: In a recent issue of the AMERICAN MACHINIST I noticed an article on worms and wheels, in which it is stated that the worms were cut with a circular cutter, in order to increase their bearing surface on the wheel. Now will you please inform me how the hob is made for hobbing these wheels? Give a description, if possible, of how it is cut; whether straight or on the same curve as the wheel. *A.*—We suppose you refer to Fig. 10, of Mr. George B. Grant's article in our issue of May 19. In that article it is stated that the "spiral gear," when provided with cutting edges, will act as a hob, and will cut the teeth in the gear. The manner of cutting the teeth in the "spiral gear" or worm is indicated by the cut referred to.

(487) J. C., Hantsport, N. S., asks: Please give me the practical methods for bending cranks from round bars of iron or steel from 2 to ½ inches in diameter. *A.*—In this country the de-

mand for crank-shafts of this kind is comparatively small, and we are not aware of any particular method used for making them. In England, where the demand for these shafts is greater, special machinery for making them is used. 2. Please give me the method for cutting out the metal between two solid forged cranks. I know all the means of doing it with lathes, drills, etc. But I believe it is done with saws; at least, I have turned cranks which had the appearance of having been sawed or milled out. *A.*—The metal between the cranks is generally slotted out. We have not seen saws used for the purpose.

(488) J. H. E., Buffalo, N. Y., writes: Assume that we have a 4,000 feet-heater, it is desirable to use exhaust steam coming through a 6-inch pipe. How large will the outlet have to be on the heater? *A.*—The cross-sectional area of the outlet should be equal to the cross-sectional area of the 6-inch pipe. 2. Assume that the heater is divided into two sections, or 2,000 feet heaters, fed by a 6-inch exhaust steam pipe. How large will the outlet have to be? *A.*—Same as before. 3. Suppose we were to feed the heater with live steam through a 3-inch pipe. How large the outlet? *A.*—The size of outlet will depend on the required amount of steam. We should use a 1-inch pipe with a globe valve attached, so that the area of the outlet can be regulated to suit the amount of steam used.

(489) A. G., ———, Oregon, writes: Please give me a method for setting the blades of a propeller. I have seen a square used, and a stick set in between the stern and rudder post, but do not know how they were set. *A.*—In all first-class establishments the propellers are fitted up in the shop, and when finished are marked, so that, in case the blades are taken off before the propeller is placed in position, the blades can be placed in the correct position on the hub, without the use of sticks and squares. If a broken blade is to be replaced, you will find the dimensions, to which the blade has to be set, on the drawing from which it has been made. If not, have these figures put on the drawing. Your own judgment will then indicate what lines will have to be erected to which the blade must be set. The sketch of the cylinder to which you refer has not been received.

(490) "Mechanic," Baltimore, Md., writes: I have a piece of knitting needle steel, out of which I wish to make steel points to be used in etching sound on brass plates. It is also used as a reproducer of sound on these plates. I have had great trouble in keeping the points (which are burnished) in good order. I hardened them in ordinary water. Is there any solution which, after heating to the color required for hardening, will make them harder than dipping in water? *A.*—The trouble is probably with the steel. Knitting needles are not necessarily of good steel, and indeed the presumption is that it is of a low grade. Get "Crescent" polished drill rods, and the probability is that you will have no further trouble. A very good way to harden the point will be to heat it in a Bunsen burner or spirit lamp, and stick the heated end into a lump of beeswax. Be *sure* not to overheat it.

(491) J. C., Pleasant, Ind., writes: I am running a seven horse-power engine, and at the end of 20 feet of line shaft I have a mill for grinding corn. The shaft makes 300 revolutions per minute. The weight of shaft and pulleys will be about 100 pounds. The shaft has three bearings. I have been told that, if I would attach the mill direct to the engine shaft, I could do the same work with less power. About what per cent. of the power do I lose by my present arrangement? *A.*—We cannot tell, since you do not give us the diameter of the shaft. The power required to drive the shaft will also depend on the conditions of the journal, bearings, and the kind of lubricant used. It seems to us that, for determining the power required to drive the shaft, the best way would be to attach a dynamometer. The change in the speed of the engine, if any has to be made in attaching the mill directly to the engine, will also have to be considered in determining the advantage gained in doing so.

(492) E. T., Philadelphia, writes: 1. Give a formula for proportioning keys for a hole of given diameter and length. *A.*—The formula most used is that given by Unwin, *i. e.*, ¼ the diameter of the shaft, plus ⅛ inch. 2. Having two gear blanks of given diameter, how can I ascertain what pitch or size of teeth to cut so that the proper number of teeth will engage? *A.*—The pitch of gears is not decided with reference to the number of teeth which will engage, but with reference to the power to be transmitted. 3. How can I ascertain the correct distance to set compasses in spacing off a gear blank, when pitch circle and number of teeth are known, so that I will come out approximately at the first trial? *A.*—Divide 180° by the number of divisions or teeth. Find the sine of this angle, and multiply it by the pitch diameter. The result will be the proper distance to set the compasses. The books and magazine you speak of can be ordered through any bookseller, who will give you the price of them.

(493) G. N., Buffalo, N. Y., writes: To settle an argument, please state the volume in cubical inches of a condenser for a compound engine (coupled at 90 degrees), with the following dimensions: High-pressure cylinder, 18½ x 18 inches; low-pressure cylinder, 29 x 18 inches; piston speed, 96 to 100 feet. *A.*—The capacity of a jet condenser is often made equal to one-third that of the cylinder or cylinders exhausting into the condenser. The capacity of the condenser should not be less than one-fourth that of the cylinder, and need not be more than one-half of it, unless the engine is a very quick running one. Condensers which are too large for the work they have to do are objectionable, because, besides their extra cost and weight, a longer time will be required to form a good vacuum in them; on the other hand, condensers which are too small for the work they have to do are liable to be flooded. In surface condensers one of the important items is the amount of the condensing surface of the tubes. The number of square feet in this surface is determined, so as to be in accordance with the indicated horse-power, the terminal steam pressure, and the temperature of the injection water. The following is considered to be good practice: For injection water at a temperature of about 60 degrees:

| | | | | | | |
|---|---|---|---|---|---|---|
| Term. pressure | 30 lbs., | absolute | 3 | sq. ft. | per | I.H.P. |
| " " | 20 " | " | 2.5 | " | " | " |
| " " | 15 " | " | 2.25 | " | " | " |
| " " | 12½ " | " | 2.00 | " | " | " |
| " " | 10 " | " | 1.80 | " | " | " |
| " " | 8 " | " | 1.60 | " | " | " |
| " " | 6 " | " | 1.50 | " | " | " |

For ships designed to trade in the tropics, the foregoing condensing surface should be increased 20 per cent.; for ships to be employed in cold climate, as reduction of 10 per cent. can be made.

(494) Crank, ———, Ind., writes: I have four 10 x 14 inches air pumps which have become eaten full of holes, the cast metal of the piston falling off in very small pieces, which, when collected, have the appearance of having been run through a crusher. The wrought-iron piston-rod has the appearance of having been subjected to a sand blast. The pumps are single-acting. The small pieces of metal falling into the pump barrels give us considerable trouble in preventing the pistons from grooving. The pistons are packed with rubber-back duck packing. I am thinking of lining the barrels with brass ⅛ inch thick. What would be the objections to the brass liners? But since the brass lining will not remove the cause, it will be only a temporary relief. The brass nuts and valve seats show none of the corrosion, or whatever it is, and therefore I believe that brass lining will be better. The pumps run two or three months without stopping. *A.*—It may be that the lubricants you use contain an acid which is injurious to the iron. The vapor in the air may also be such as to act injuriously on the iron; or it may be the combination of the vapor in the air and lubricants used which causes the trouble. Since the brass valve seats and nuts are not affected, it seems to us that a brass lining will give you more than a temporary relief, and should be adopted. 2. The main engines have 20 x 18 inches steam cylinders; the cranks are set at right angles to each other. The engines make from 3 to 30 revolutions per minute, pumping against a pressure of 25 pounds per square inch with 13 x 18 inches water cylinder, crank and fly-wheel pumps; and as the greater part of my running is below 8 revolutions per minute, I can get but little expansion. Now I have a direct-acting pump with 12 x 12 inches steam and 9 x 12 inches water cylinders, which at present is not running. Would there be any gain by running the exhaust of the large engine into the steam pipe of the small pump, so as to make the two engines run on a compound principle? And would it be necessary to have a receiver? I would have about 50 feet of 2½ inch pipe between the cylinders. *A.*—With this arrangement there will not be any gain; on the contrary, we believe there will be a loss. Because in compounding the engine the steam should be taken from the smaller cylinder into the larger one; in your case it will be the opposite; that is to say, the large cylinder will be the high-pressure cylinder, and the smaller one the low-pressure cylinder. True, it might be possible to run the small pump at such an increased speed as to take all the exhaust steam from the large engine; but from the data you have given us we believe such an arrangement is not practicable. Even if it were practicable, the irregular speed of the large engine will be a serious difficulty in the way of successfully applying a compound system.

## BUSINESS SPECIALS

*Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue.*


Gear wheels and g-cutting. Grant, see adv., p 16.

Link-Belting.

Send for Catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

Link-Belt Machinery Co., Chicago and N. Y.

Small Electric Arc Light Plants,

3, 5 and 10 arc lights and up,

Waterhouse Electric & M'f'g Co., Hartford, Ct.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Lamb-Knitting Machine Co., Chicopee Falls, Mass.

Fuel oil burners. A. E. Jenkins, Scranton, Pa.

"The Bulldozer," a new departure; forging by pressure. M'f'd by Williams, White & Co., Moline, Ill.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

"Swift" Sight Feed Lubricator; no glass tubes; simple, reliable. Swift Lub'r Co., Elmira, N. Y.

Davis Key-Seating Machines, kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

Working drawings furnished by A. L. Stevens, mech. engineer, 11 S. Ninth st., Philadelphia, Pa.

"How to Keep Boilers Clean." A book mailed free by James E. Hotchkiss, 120 Liberty st., N. Y.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Brown & Sharpe Mfg. Co. have a line of machinery with S. A. Smith, 23 S. Canal st., Chicago, Ill.

Patents—Whittlesey & Wright, 705 8th st., N. W. Washington, D. C. Send for pamphlet and references

Ice and Refrigerating Machines, 124 built, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Engine lathes, hand lathes, fine tools, files and supplies for machinists and other metal workers. Frasse & Co., 92 Park Row, N. Y.

Most sensitive and durable Damper Regulator made; works within one pound; send for circular. T. Kieley, 11 W. 13th st., New York.

Upright drills, improved, sizes 21", 23", 25", 28", 32", 36" swing; finely made and great capacity. Currier & Snyder, Worcester, Mass.

Split Pulleys at low prices and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

Machinists' supplies, brass goods, m't'rs supplies, polishing materials, all kinds wire, metals, etc., in any quantity. Jordan & Gottfried, 208 Canal st., N.Y.

Fine tools and supplies for machinists and other metalworkers. Get our prices before purchasing elsewhere. Montgomery & Co., 105 Fulton st., N. Y. City.

Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See Oct. 6, p 15. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

The Holly Manufacturing Company, of Lockport, N. Y., will send, on application, their pamphlet illustrating pumping machinery and reports of duty trials.

W. H. Hoffman, consulting engineer, 108 Liberty st., room 3, N. Y. Mechanical engineering in all its branches; working drawings for the transmission of power by steam, water, air and electricity.

Contract work of all kinds executed promptly and on reasonable terms. Parties wishing gray iron castings in large quantities can make money by corresponding with Rawson Mfg. Co., Hornellsville, N.Y.

A system of easy lettering by J. H. Cromwell, giving 26 forms of alphabets. The space to be lettered being divided into squares; simple and effective. Price 50 cents. Catalogue of books for engineers free. E. & F. N. Spon, 12 Cortlandt st., N. Y.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

"Practical Drawing," by J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including Nov. 3, 1888 issue, 62 articles have been so far published. Copies containing these articles, sent by mail to any part of this country or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

"Modern Locomotive Construction," by J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 76 articles have thus far appeared up to and including the Oct. 27, 1888 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.


## MANUFACTURES

H. W. Smith & Co., Bangor, Me., are building a saw mill.

Goelet & Co.'s planing mill, at Toledo, Ohio, was recently destroyed by fire.

The Oregon Foundry Company has been chartered, to do business at Oregon, Ill.

The capacity of the Athens (Ga.) Foundry and Machine Shop will be doubled.

The flour mill of Wheeler & Wheeler, Briceville, Ky., lately burned, will be rebuilt.

The Spoke Works of Dr. Deardorff, of Carlisle, Pa., were recently destroyed by fire.

George Dailey & Son are adding machinery to their machine shop at Pine Bluff, Ark.

The East Tawas Lumber and Salt Company's mill, at East Tawas, Mich., was recently burned.

Nelson Tenney & Co. are to start in the manufacture of tin and sheet-iron goods at Portland, Me.

The Hill Friction Clutch Pulley Company, Cleveland, Ohio, are increasing the capacity of their works.

The Vicksburg, Shreveport & Pacific Railroad Co. are building a new blacksmith shop at Monroe, La.

The Lowell Machine Shop, Lowell, Mass., is said to have 1,200 hands employed in building cotton machinery.

Fay & Scott, Dexter, Me., have recently filled orders for machine tools for railway shops in Mexico.

The Rankin & Fritch Foundry and Machine Co., St. Louis, Mo., are increasing their facilities for manufacturing.

The Hyde Iron Works, Bath, Me., formerly known as the New England Marine Engine and Machine Works, have been started up.

The Minersville (Pa.) machine shops, idle for several years, have been purchased by L. S. Allison, of Hazleton, and are being put in operation.

Additions now being made to the foundry and machine shops of James P. Witherow, New Castle, Pa., will double the capacity of the machine shop.

The Waterloo Manufacturing Co., Waterloo, P. C., has been incorporated, with a capital stock of $100,000. They will manufacture agricultural implements, and do a general foundry business.

William McFarland & Co. are putting the machinery in their silk mill, at Bayonne, N. J. They expect to employ 300 hands. The factory is three stories high, 50 x 150 feet, with separate boiler and engine room.

Referring to a paragraph in our October 20th issue, we are informed that Bement, Miles & Co. are now building for their own use a radial drill, having a 10 ft. arm, having previously built several of this size for other shops.

There is water-works agitation at Castile, N. Y.; Everett, Pa.; Reynoldsville, Pa.; Waterbury, Conn. Elsinore, Cal.; South Denver, Col.; Cardiff, N. Y.; Burlington, Wis.; Yorkshire Center, N. Y.; Abingdon, Va.; Gilroy, Cal.; Las Animas, Cal.

The American Engine Co., of Cedar Rapids, Ia., and the American Nail Machine Co., of Findlay, Ohio, have consolidated and formed a company; with a capital stock of $250,000. The company will make nail machines and high-speed engines.

The Lorain Manufacturing Company, Lorain, Ohio, have completed and are now occupying their additions made to plant this summer, consisting of planing mill 100 x 50, for supplying bath-tub department, together with iron foundry 200 x 90, for increasing output of soil pipe. Their floors now cover an extent of three acres. C. H. Comstock, manager.

The Albany Steam Trap Co., Albany, N. Y., write us that they have been quite busy this summer and fall in filling orders for the Blessing filter. They have recently sold to the Athol (Mass.) Water-Works, a large 8-foot filter, to be used for the city water supply; also two 8-foot filters to the Fort Orange Paper Company, and several large ones for laundries, woolen mills, breweries, etc.

Timothy Kieley, 11 West Thirteenth street, New York city, has brought out a new damper regulator, designed to keep uniform pressure on a boiler. The damper is actuated by a diaphragm, and this in turn is controlled by another diaphragm, which may be arranged to lift at any desired pressure by the use of more or less attached weights. This regulator, it is claimed, will work with a very slight variation in pressure.

Hauck & Comstock, of Mechanicsburg, Pa., manufacturers of agricultural implements and general machinery, whose works were destroyed by fire on August 27th, have their new shops nearly finished, and a large portion of their machinery in operation. All the tools bought by this firm are of late approved designs, and the entire plant is admirably arranged to secure lowest cost of production. The new buildings are one-story brick, heated by overhead steam pipes, and lighted by gas.

The Reliance Gauge Co., of Cleveland O., report rapidly growing demands for their safety water columns, from all parts of the country. Among the orders recently booked, are 32 for the Reading Iron Works of Philadelphia, Pa., 10 for the California Electric Light Co., of San Francisco, 6 from Australia, and 3 from the City of Mexico. Among the large concerns who have recently adopted these safeguards, are The Whiteman Paper Mills, of Dansville, N. Y., and the Fall Mountain Paper Co., who are placing them in their several mills located in Vermont, New Hampshire, and Massachusetts.

The *Railway Review* says: The C. A. Treat Car Wheel Works, of Hannibal, Mo., will erect a branch car wheel foundry at East Chicago. The main foundry room will be 260 x 90 feet; the engine room, 24 x 26 feet; the melting room, 22 x 43 feet; the pitting room, 25 x 62 feet; the machine shop, 50 x 50 feet; the core room, 26 x 40 feet; and the office 14 x 16 feet. Over the office will be a drafting room 14 x 16 feet, and a pattern shop over the machine shop 50 x 50 feet. Ten swinging pneumatic cranes will be constructed in the main foundry, and elevated tracks for the transportation of wheels will be used throughout the building. Adjoining the engine room will be a suite of rooms for the workmen, arranged with lockers, closets, wash sinks and hot and cold shower-baths. It will have a capacity of 400 wheels per day, which means the melting of 120 tons of iron. The foundry will cost $50,000, and be one of the most complete of its kind in the West.

The Gardiner (Me.) machine shops are all busy. Joseph Perry is furnishing a large amount of shafting, gearing, etc., for a saw mill at North Waldoboro, and is also making board circulars and shingle machines for other parties. C. A. Robbins & Sons have done a large job for the Cochrane-Oler Ice Company, and have contracted to furnish engine, boiler, shafting and other machinery for the new shoe factory in Richmond. P. C. Holmes & Co. are now at work on their twenty-third improved Holmes wheel, and report that these new water wheels are proving very successful. Harvey Scribner reports that his business was never better than it has been the past season, while the prospects ahead are bright. He has just shipped shingle machines to Fort Fairfield and Waldoboro. He is now at work making a board circular, a new Curtis wheel for the Richards Paper Company, Gardiner, and eight of the improved Richards pulp screens for the Carrabassett Pulp Mill at Skowhegan.—*Industrial Journal.*

## Machinists' Supplies and Iron.

NEW YORK, Oct. 27, 1888.

Iron—American Pig.—There has been during the past few days a limited demand in the market, though prices are firmly held. We quote Standard Lehigh and North River brands, $18.50 to $19 for No. 1 X Foundry. No. 2 Foundry, $17 to $17.50. Grey Forge $15.50 to $16.25.

Scotch Pig.—We quote Coltness, $21.50 to $21.75; Gartsherrie, $21; Summerlee, $21.75 to $22; Eglinton, $19.25 to $19.50; Dalmellington, $20.25 to $20.50; Clyde, $20.50, and Langloan, $20.50.

# ✲WANTED✲

*"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.*

Wanted—Men to examine S. S. planes; see p. 11.

Draftsman—A competent man wants situation as assistant draftsman. Age, 30. Box 37, AM. MACH.

A first-class pattern maker, English, wants a position as foreman; good draftsman; age 33. Box 35, AMERICAN MACHINIST.

Wanted—Two first-class vise hands, accustomed to engine work. Davenport Foundry & Machine Co., Davenport, Iowa.

Wanted—Travelers for New England and Middle States, to handle mechanical goods; liberal commission. Box 17, AMERICAN MACHINIST.

Wanted.—A working foreman for machine shop, one who can handle men and do work in modern style. Country, AMERICAN MACHINIST.

An experienced mech. draftsman wants situation; is a machinist and technical school graduate. Address A. L., AMERICAN MACHINIST.

Foreman Wanted—One competent to take charge of a machinery pattern shop. Address, with record of experience and reference, Box 93, Albany, N. Y.

Permanent situation wanted by a first-class, sober pattern maker, who is accustomed to engine and general machinery. Pattern Maker, AM. MACHINIST.

First-class mech. draftsman, 33 years old, with good experience, able to take charge of drawing office, wants to change position. O. P., AM. MACH.

Wanted immediately, four first class Brass Moulders; none others need apply; permanent situations; apply to Martin Anti-Fire Car Heater Company, Dunkirk, New York.

Foundry foreman of 20 years' experience desires to enter into a contract with a responsible firm to make their work by the ton or take charge. Address Box 36, AMERICAN MACHINIST.

Draftsman—A practical man with technical education, and some good experience, wants a situation. Dies and special machinery preferred. Good references. Address J. R., AMERICAN MACHINIST.

Wanted—Tool Maker—A competent workman can find steady work in factory tool department, employing six hands. Address, stating your experience, and wages expected, Ohio, AM. MACHINIST.

Wanted—A draftsman who understands saw mill machinery; also a pattern maker; steady employment. Address, with full particulars and salary expected, D. J. Murray M'f'g Co., Wausau, Wisconsin.

Wanted—Situation by a first-class practical machinist, accustomed to engine work, jobbing and tool making; or would take charge of a shop or the erecting of work outside. Address J. B., care AMERICAN MACHINIST.

Wanted—English fitters or turners returning home, who have worked in first-class shops in New England, manufacturing highly finished work, to please apply, either by letter or personally, to George Richards & Co., Limited, Broadheath, near Manchester, England.

First-class man wants permanent position as superintendent with firm desiring to build Corliss engines. Has designed full line of successful Corliss engines for a prominent firm. Non-condensing, condensing and compound. Large sizes a specialty. Posted on prices and modern methods of doing work. Permanent, AMERICAN MACHINIST.

A large manufacturing establishment in St. Louis, running a foundry for making their own specialties, also doing regular job work, wants to correspond with a competent man to take charge of said foundry. Must be a thoroughly competent and reliable man in every respect. Address Box 34, AMERICAN MACHINIST, giving references, and salary expected.

## ✢ MISCELLANEOUS WANTS ✢

*Advertisements will be inserted under this head at 35 cents per line, each insertion.*

The Cyclone Steam Flue Cleaner is king, and has no rival. Crescent Mfg. Co., Cleveland, Ohio.

Crescent grease cup for shafting beats them all. Sample free. Crescent Mfg. Co., Cleveland, Ohio.

Light and fine machinery to order; Foot Lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

August C. Christensen, 24 State st., N. Y., consulting engineer for hydr. and pumping machinery, etc.

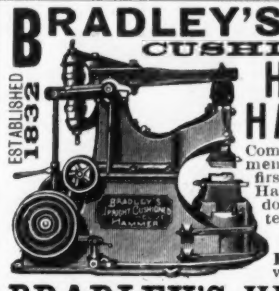
Correspondence solicited with parties having machine or foundry specialties to build. Honesdale Iron Works, Honesdale, Pa.

Wanted.—To buy second-hand lathes, planers and shapers of all sizes; must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati O.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

Wanted—Inventors to know that business placed in my hands receives my personal attention from beginning to end. R. G. DuBois, Patent Attorney, Washington, D. C.


BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER



ESTABLISHED 1832

Combines the best elements essential in a first-class **Hammer**. Has more good **points**, does more and better work and costs less for repairs than any other **Hammer** in the world.

BRADLEY'S HEATING FORGES.

ESTABLISHED 1832

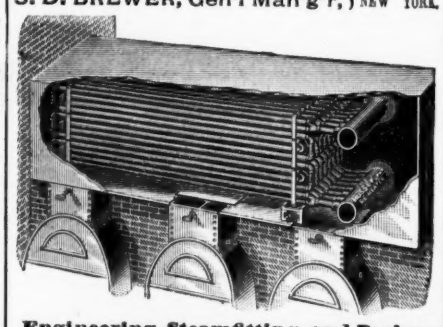
With a manufacturing experience of over half a century, we recommend these machines to be the best, simplest, most durable and combining all the essential elements. **For hard coal or coke.** Indispensable in all shops. keep **Bradley's Cushioned Hammers** and men fully employed and reduces cost of production.

Pat. Aug. 30, 1887.

BRADLEY & CO. SYRACUSE, N. Y.

THE HUSSEY RE-HEATER and STEAM PLANT IMPROVEMENT CO.

A. S. HATCH, President, S. D. BREWER, Gen'l Man'g'r, } 15 Cortlandt Street, NEW YORK.



**Engineering, Steamfitting, and Designing, Remodeling and Improving Steam Plants. Consulting experts in all matters pertaining to the use of Steam and Heat.**

FOR SALE.

CABLE DRIVING PLANT.

The two 26" x 48" automatic cut-off horizontal Steam Engines, lately used to drive the cable on the N. Y. and Brooklyn Bridge Railway; designed by E. D. Leavitt, Esq., and built by the Dickson Manufacturing Co. The fly-wheels are 18 feet in diameter and weigh 30,000 pounds. These engines were run singly, and together were in use about five years; they are in good condition and will be sold as they stand, with fittings, entire and ready for service.

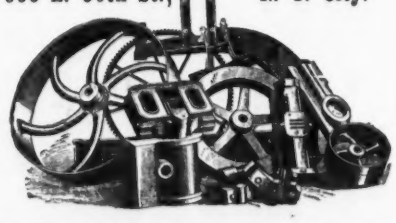
Also, completing the cable driving plant, a lot of 10 foot sheaves, one pair of 12-foot driving drums, one 5-foot friction drum, and one set of 12 and 5-foot cut driving gears, all new; one similar set of gears, worn, with clutches, shafts and pillow blocks.

Apply to C. C. MARTIN, Chief Engineer and Superintendent, 22 Sands St., Brooklyn, N.Y.

A GREAT DISCOVERY.
IMPORTANT TO STEEL WORKERS.

We are now prepared to introduce, after thorough and repeated trials by some of the largest concerns in the country, a Steel Tempering Solution that will temper Dies, Rolls, Springs and all kinds of Steel Tools, uniformly and perfectly. Sample jars will be shipped for cost of material—50 cents and express charges. Accompanying each will be price list, with discounts for quantities.
EMPIRE CHEMICAL CO., 21 John St., New York.

Iron Foundry of T. Shriver & Co., 333 E. 56th St., N. Y. City.



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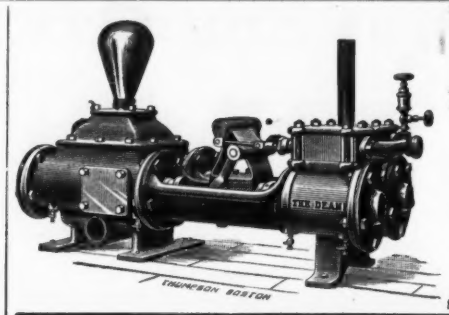

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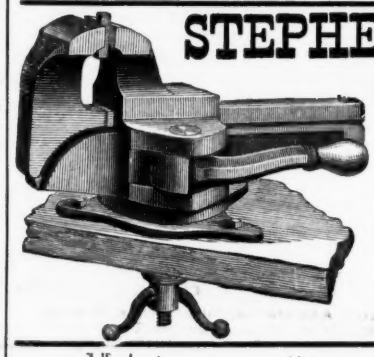

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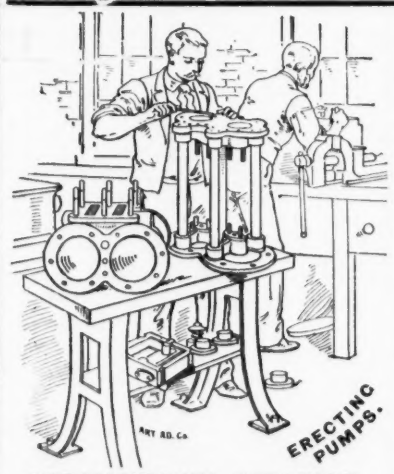

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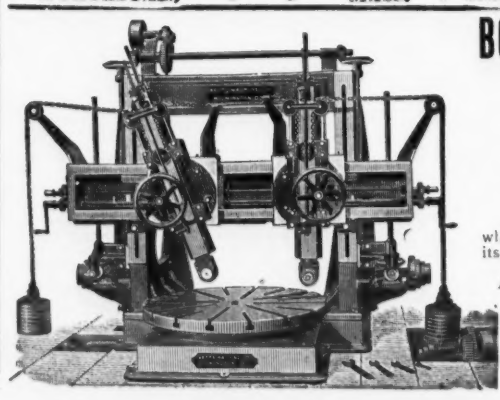

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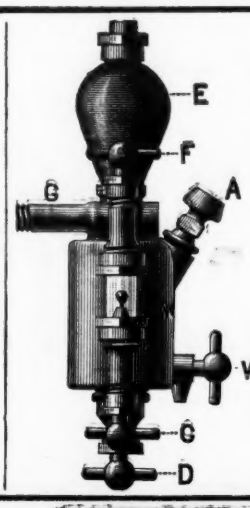


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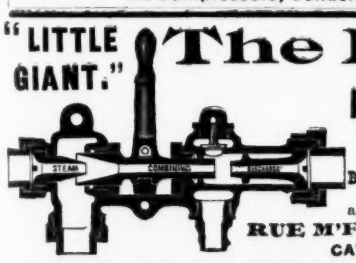


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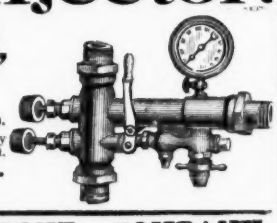

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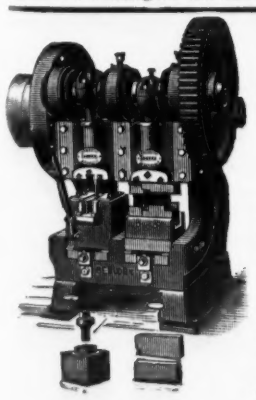

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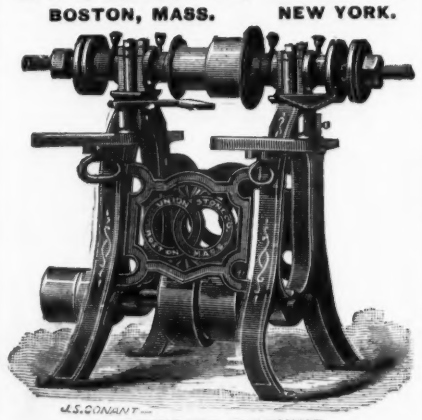

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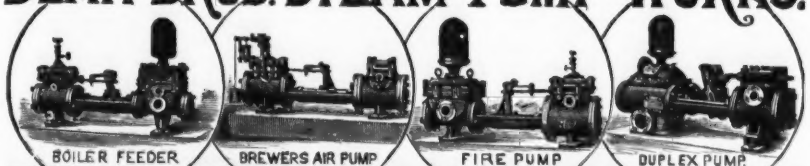


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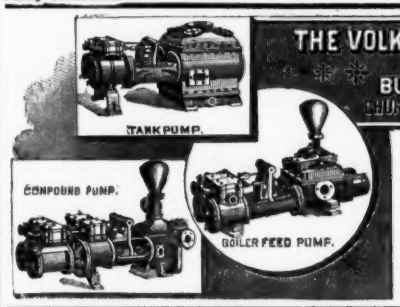


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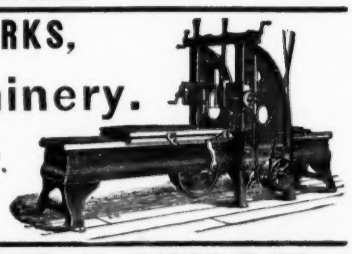

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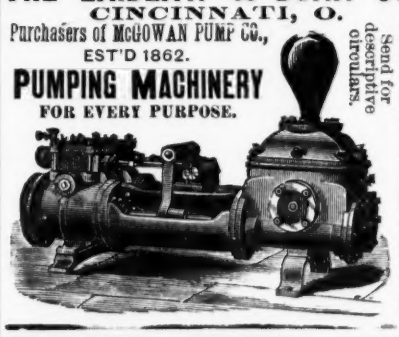

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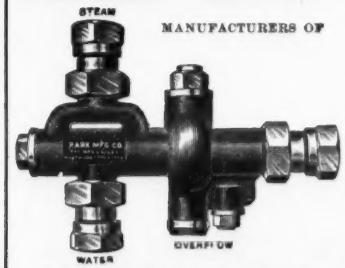


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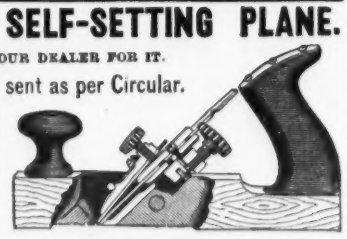

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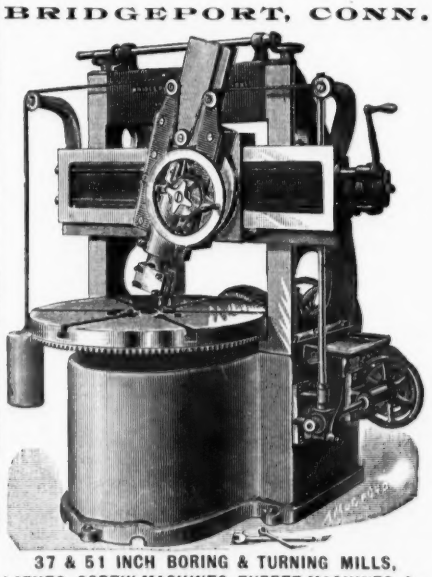

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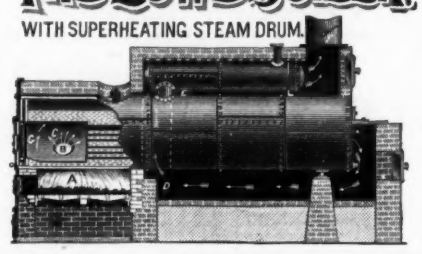

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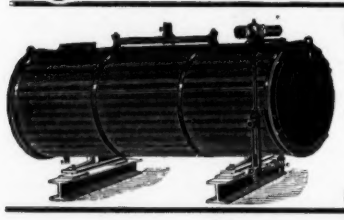

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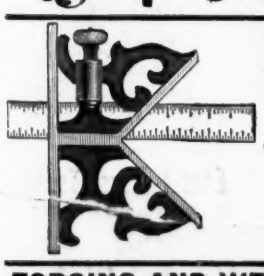

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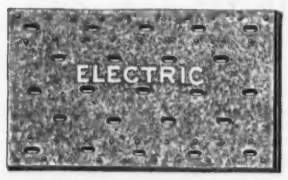


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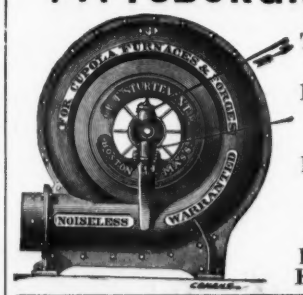


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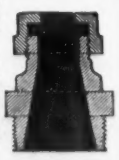

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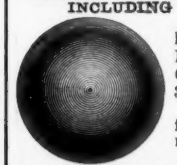

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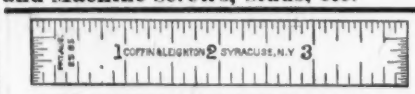


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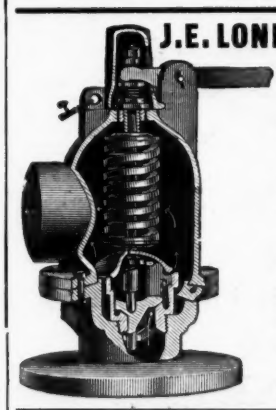

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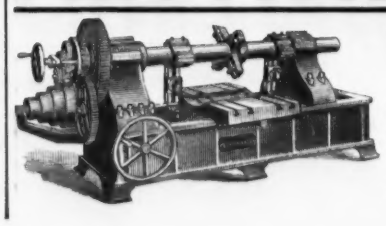

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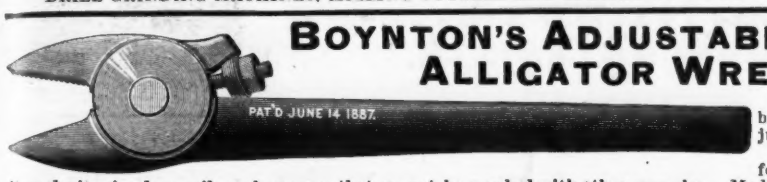


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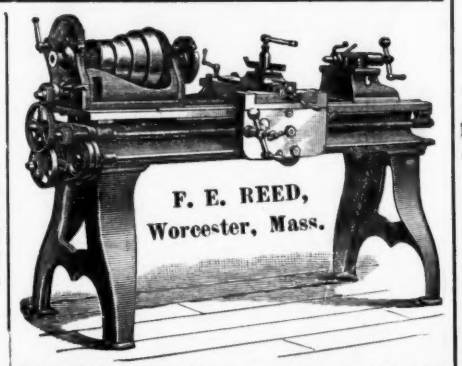


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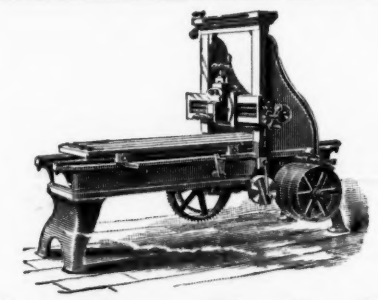

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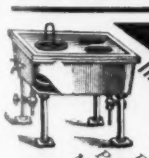

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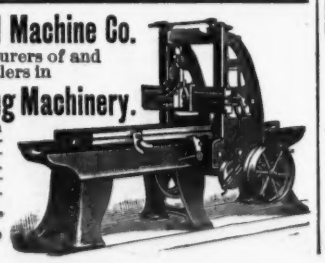

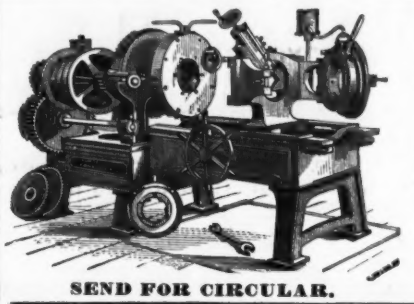

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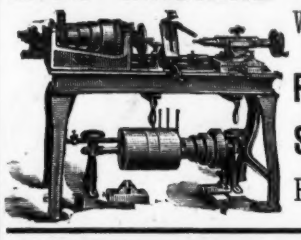

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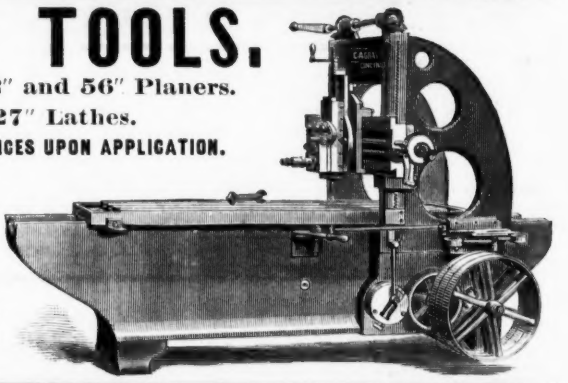

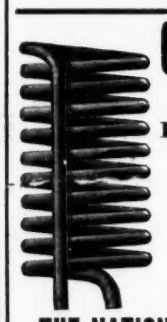

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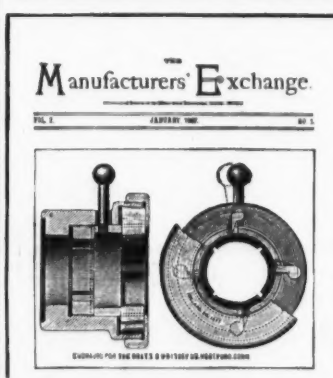


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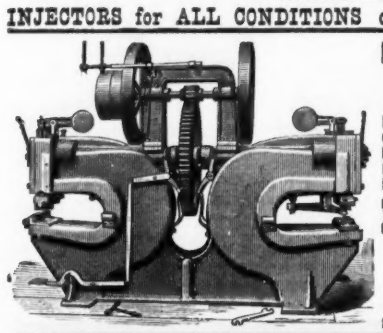

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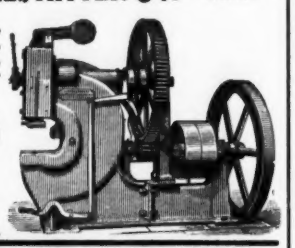

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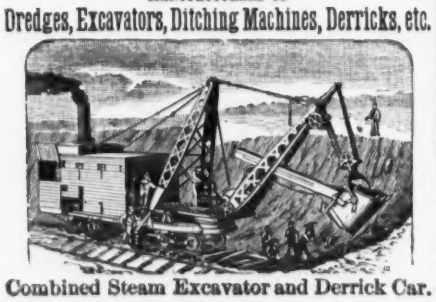

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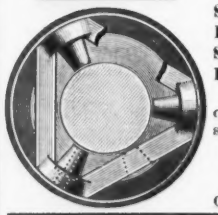

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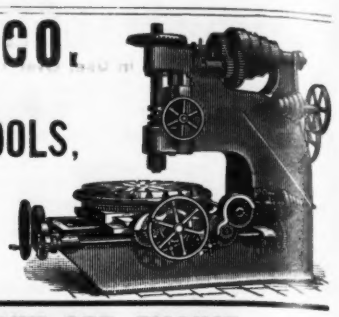

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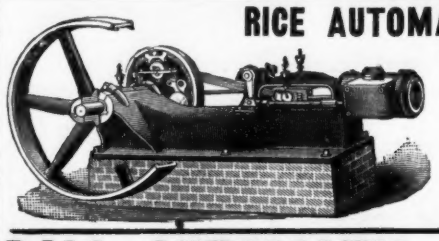
## RICE AUTOMATIC CUT-OFF ENGINE.



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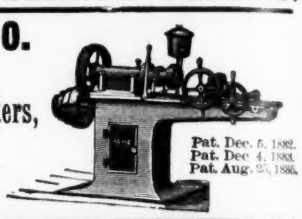

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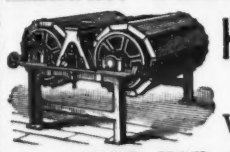

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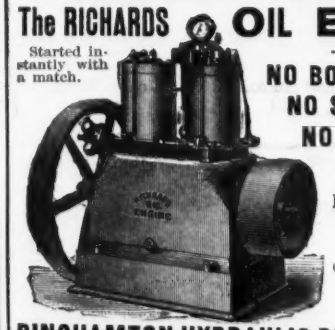

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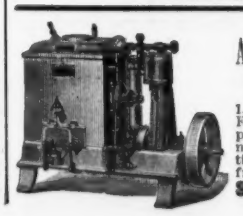

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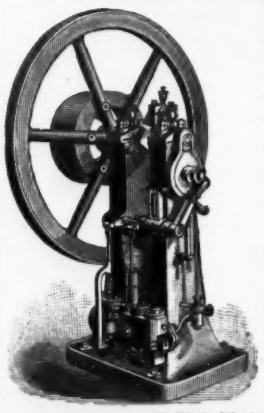

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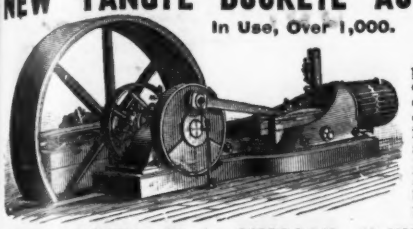

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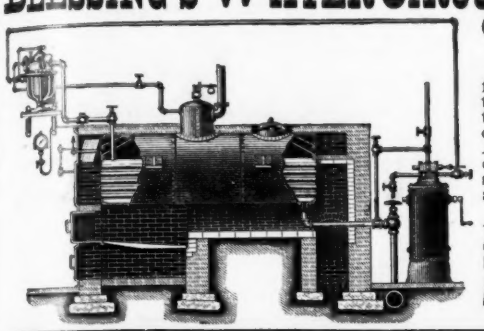

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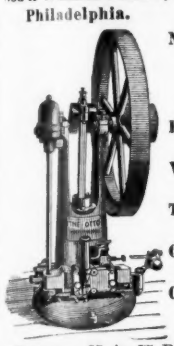

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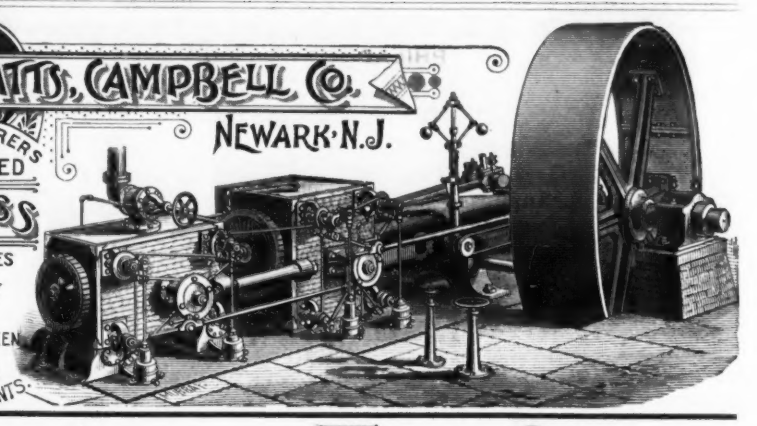

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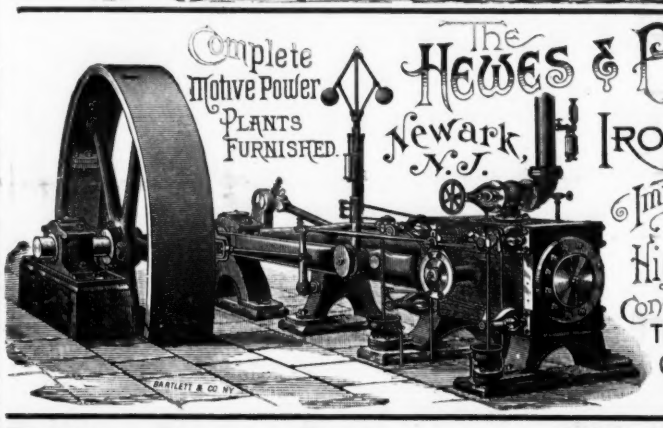

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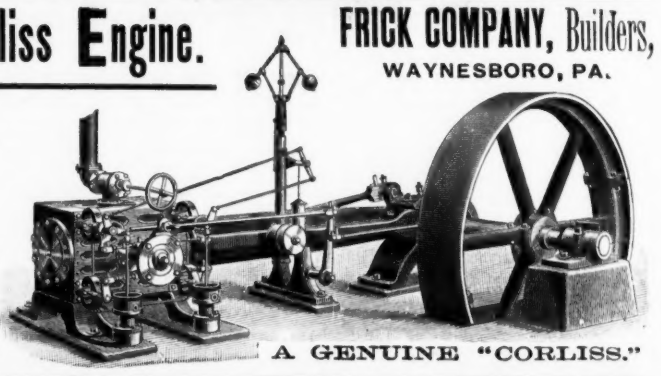

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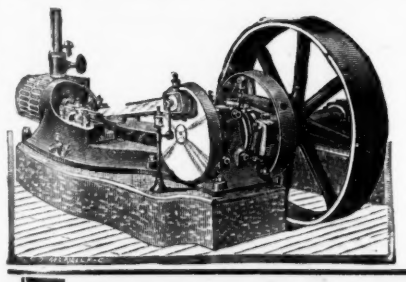

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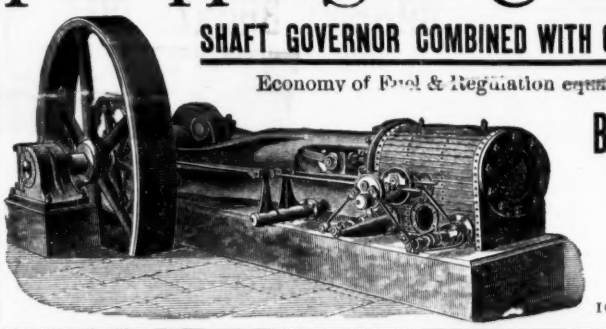

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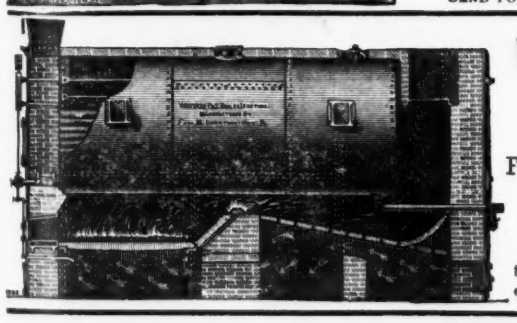

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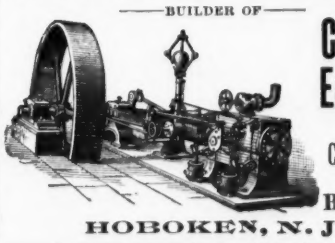

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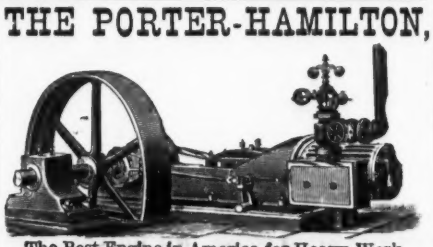

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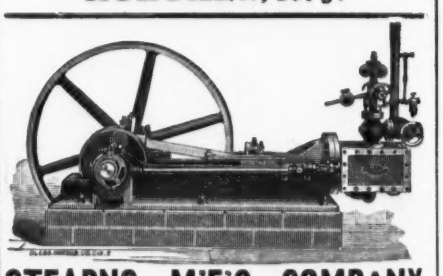

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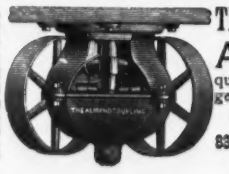

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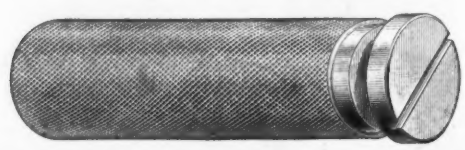

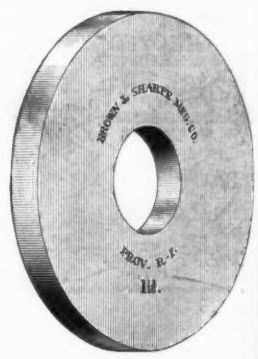


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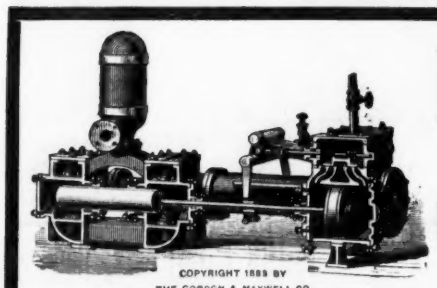


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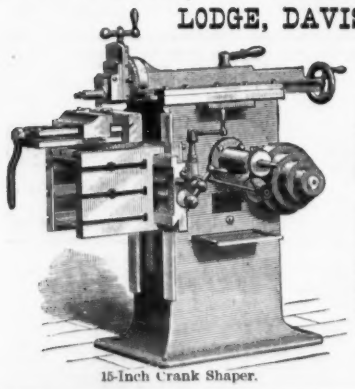
## SHAPERS, ENGINE LATHES AND DRILLS.

**LODGE, DAVIS & CO., CINCINNATI, OHIO.**



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20 inch Upright Drills. 25 inch Back Geared,
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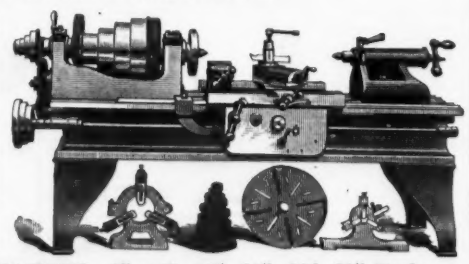

**SHAPERS, 8", 10", 15", 20", 26", 32" Stroke.**
**ENGINE LATHES, 17", 19", 21", 24", 27", 30", 42".**

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The only one built on **correct principles.**
More **economical** than any we have ever used.
Can do **double** the work. Most convenient.
**Best** in the market. Much admired.
No trouble or expense for repairs.
Could not ask for anything better.
There may be as good a one made by some one else, but **I have not seen it.**
I feel that **I did wisely** in buying your tool.
We consider it a **model tool** and fills the whole bill.

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| Eames Vacuum Brake Co., Watertown, N. Y. | 4 " |
| Carnegie, Phipps & Co., Pittsburgh, Pa. | 2 " |
| American Brake Co., St. Louis, Mo. | 3 " |
| Worthington Pump Works, Brooklyn, N. Y. | 2 " |
| King Iron Bridge Works, Cleveland, O. | 9 " |
| Filler & Stowell Mfg. Co., Milwaukee, Wis. | 2 " |
| Hutchinson, Hollingsworth & Co., England | 3 " |
| Daft Electric Light Co., Marion, N. J. | 2 " |
| C. H. Hunt & Co., New York City | 2 " |

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Morgan Engineering Co., Alliance, O.
Grand Trunk Railway of Canada, Montreal, Can.
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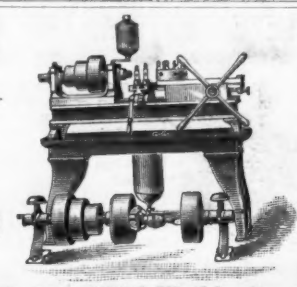

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**HORIZONTAL**
## Boring Mills,
48 in. and 66 in. Swing.

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For ⅝ in., 3 in. and smaller holes.

**Revolving Head Drilling Machines.**

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DROP FORGED OF
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IN 16 SIZES.

TAKING NUTS FOR ¼ INCH UP TO AND INCLUDING NUTS FOR 1¾ INCH BOLTS.

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**Formerly of Worcester, Mass.**

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A machine shop 500′ long by 100′ wide; a foundry 250′ long by 90′ wide; also commodious buildings for the storage of sand, coal, coke and pig iron; ample and convenient wash rooms for the men; fireproof two story pattern storage; blacksmith shop; engine and boiler houses. These buildings are detached from the machine shop and foundry. There is an elevated railroad for the convenient distribution of raw materials, and a railroad running through the machine shop for shipping. The whole plant is supplied with the incandescent system of electric lighting.

The machine shop and foundry have overhead traveling cranes running through their entire lengths; also light traveling cranes, which serve every tool, and a number of jib cranes in the foundry and scratch rooms. The foundry has capacity for making the heaviest class of castings.

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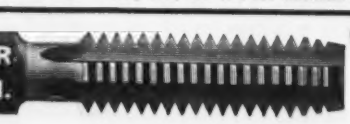

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